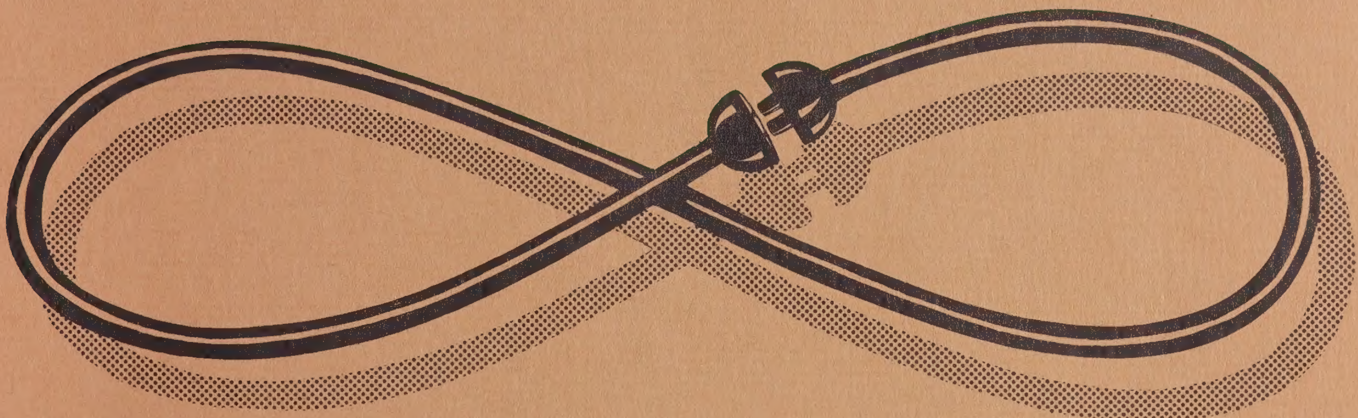
San Francisco Bay Area

REGIONAL ENERGY PLAN



PHASE I REPORT — FEBRUARY 1980

ABAG

DRAFT

San Francisco Bay Area

REGIONAL ENERGY PLAN

Phase I Report

Prepared for

U.S. Department of Energy
and
U.S. Environmental Protection Agency

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ABAG

February 1980

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INTRODUCTION

The Regional Energy Plan for the San Francisco Bay Area is being developed under joint funding from the U.S. Department of Energy and the Environmental Protection Agency. The primary focus of the effort is on examining what cities and counties can do to help conserve non-renewable forms of energy and to balance energy considerations with environmental, social and economic factors. The program as currently outlined consists of three phases: Phase I was devoted to preliminary data collection, methodology development, and work program preparation for Phase II; Phase II will include the major technical work to develop a Regional Energy Plan that is integrated with the ABAG Environmental Management Plan and the Regional Comprehensive Plan; Phase III will emphasize assisting local governments in the Bay Area in developing energy programs suited to local constraints and desires.

Functionally, the staff work is divided into four major task areas:

- o Development of an energy consumption and demand data base (historical and projected) that is appropriate to the Bay Area. These data will constitute the technical basis for whatever plan recommendations are adopted.

- o Development of alternative future energy supply and demand scenarios for the Bay Area.

- o Development and evaluation of sets of alternative energy policies and programs appropriate for ABAG and local government adoption. Plan alternatives would be primarily developed using existing information and experience generated in numerous recent studies conducted in California and elsewhere. This task will include adoption and implementation of the Energy Plan by ABAG, and provision of technical assistance to local governments interested in developing energy programs.

- o Integration of the Energy Plan with the Environmental Management Plan and Regional Comprehensive Plan including evaluation of potential "cross impacts" among the plans, and recommendations for comprehensive energy and environmental decision-making.

The Phase I effort consisted of a number of tasks to collect data and design the methodologies to be employed for the remaining program. Specifically, these tasks were:

- o Collection of energy supply and consumption data for the Bay Area;

- o Development of a methodology for regional energy demand forecasting;

- Preparation of an inventory of energy conservation alternatives for local governments, including a survey of existing local government energy conservation activities within the region;

- Methodology development and preliminary assessment of energy impacts of adopted air, water, and solid waste management programs;

- Preparation of an inventory of agencies and institutions with responsibilities related to energy supply and conservation;

- Establishment of a regional Energy Advisory Committee composed of local government planning and public works personnel, and representatives of interested community groups.

The results of these tasks are summarized in this Phase I report. More detailed supplementary information for certain tasks is contained in the accompanying appendices.

PHASE I RESULTS

ENERGY SUPPLY AND CONSUMPTION DATA COLLECTION

Energy supply and consumption data were collected in Phase I to characterize historical patterns of energy use in the Bay Area. This characterization will provide the basis for the development of future energy supply scenarios, and will serve as input to the assessment of the energy conservation potential in each consuming sector. In general, data regarding energy supply that are specific to the Bay Area are not readily available from primary sources. In most instances, additional "digging" or development of methods for converting the available data are required to prepare a supply and consumption data base with the appropriate geographic and historical coverage. Thus, Phase I was devoted to the collection of available data regarding energy supply and consumption while Phase II will consist of developing from this data a consistent historical data base specific to the Bay Area, as well as future supply scenarios.

Energy is supplied to the San Francisco Bay Area in three forms: electricity, natural gas and petroleum products. These three categories of energy are not mutually independent. For example, electricity can be generated via the combustion of natural gas and/or petroleum. However, these are the most commonly known forms of energy and most of the available data address them.

Electricity and natural gas are supplied to the region by Pacific Gas and Electric Company (PG&E), a private, investor-owned utility which generates and distributes electricity, and procures and distributes natural gas to most of northern and central California. Within the PG&E service area are several publicly owned utilities which are integrated into the PG&E system. The San Francisco region lies entirely within the PG&E service area and thus all the electricity and natural gas consumed is monitored by PG&E.

The supply of petroleum fuels for the Bay Area has historically been in the form of both crude oil and refined products. The crude oil is shipped to the area refineries for processing. Generally, the refined petroleum products are imported into the region by these same refineries. Each refiner maintains records of the amount of crude oil received, the amounts of finished products, and their destinations. These records are generally not accessible to the public, though there are secondary sources of information such as the American Petroleum Institute, Lundberg Survey, Inc., the State Board of Equalization, and the California Energy Resources Conservation and Development Commission (commonly referred to as the California Energy Commission or CEC).

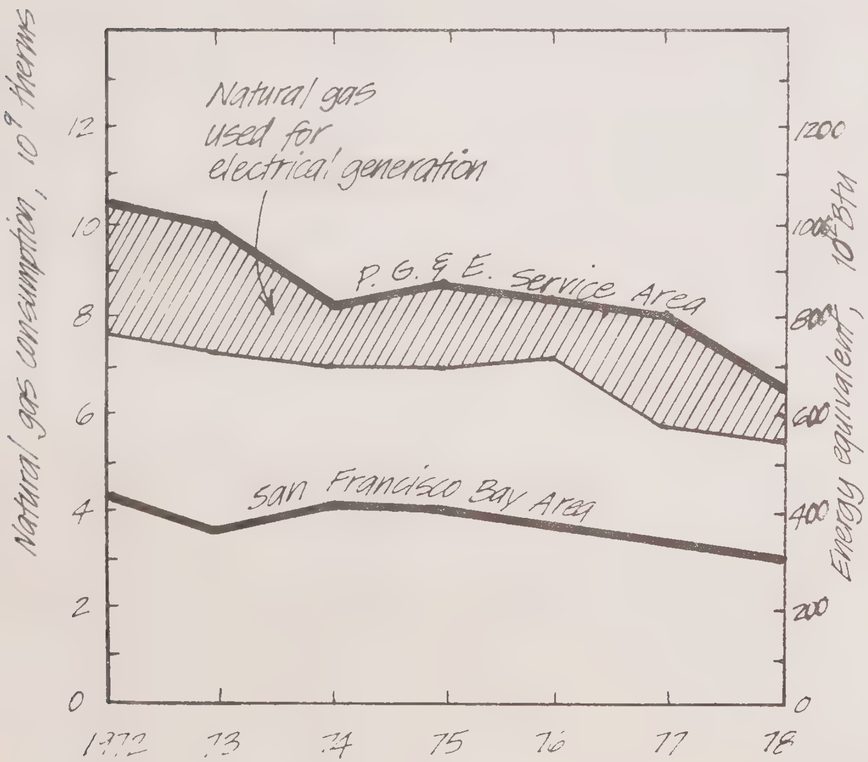
TABLE 1

SUMMARY OF HISTORICAL ENERGY SUPPLY DATA

Data Source	Energy Form	Description
PG&E	Electricity Natural Gas	o Historical electricity and gas sales on a county by county basis by customer type reported on a monthly basis. o Monthly historical records of the types and quantities of fuels/energy used to produce electricity on a system-wide basis. o Historical records of PG&E electric and gas sales and purchases.
California Board of Equalization	Gasoline	o Monthly summaries of gasoline distributed to the state.
California Energy Commission	Electricity Natural Gas Petroleum	o Quarterly tabulations of the amounts of various types of energy coming into and leaving the state. o Quarterly tabulations of state energy production. o Quarterly tabulations of the amounts of natural gas and petroleum used to generate electricity within the state.
U.S. Department of Energy	Electricity Natural Gas Petroleum	o Yearly summaries of U.S. and California energy production, energy imports and exports.

Figure 1.

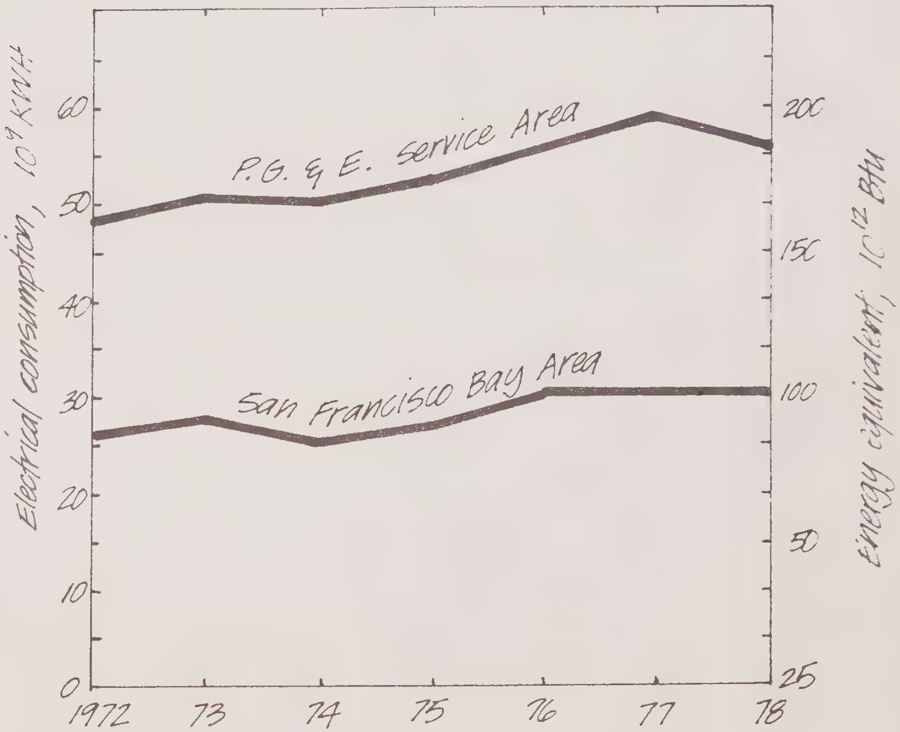
Natural gas consumption trends, 1972 –1978



Source: Pacific Gas & Electric Company

Figure 2.

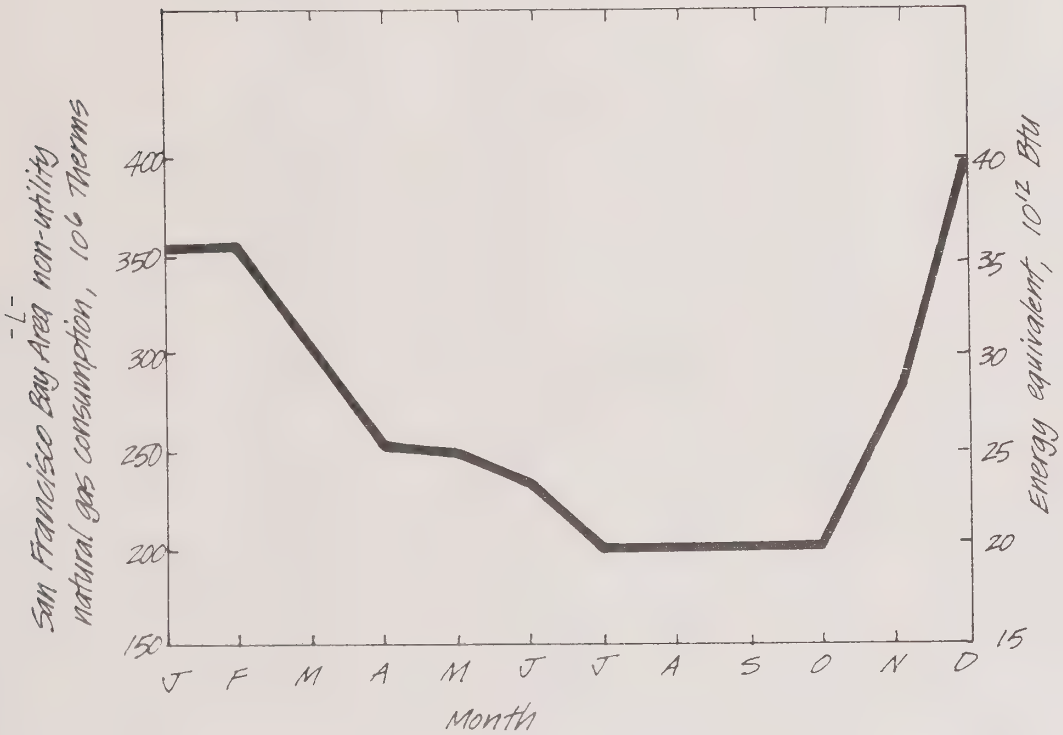
Electrical consumption trends, 1972 – 1978



Source: Pacific Gas & Electric Company

Figure 3.

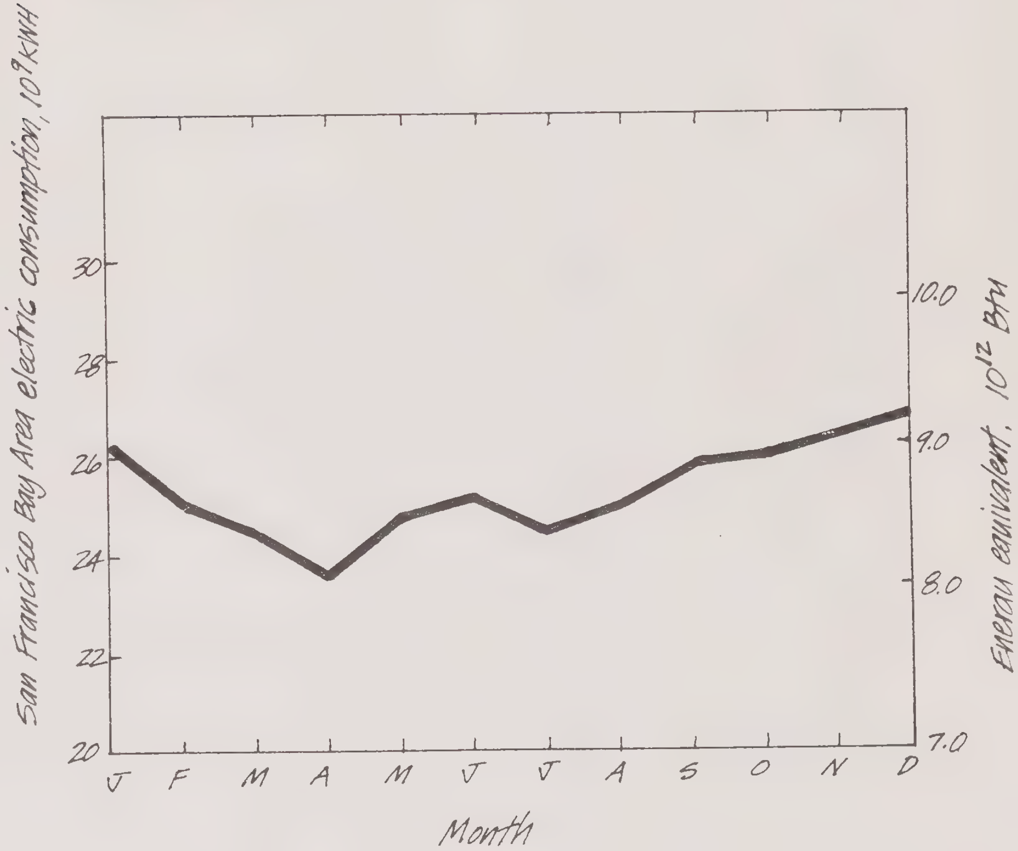
Monthly variation in natural gas consumption for the San Francisco Bay Area, 1978



Source: Pacific Gas & Electric Company

Figure 4.

Regional variation in electrical consumption, 1978



Source: Pacific Gas & Electric Company

great a monthly variation. This is primarily because electricity is used for both heating and air conditioning. The highest rates of consumption occurred during the winter and the lowest during the spring when the heating and cooling requirements are the least.

There is also a great variation in the amount of energy consumed by each of the nine counties. The physical size of the county and its population and industries determine the amounts of energy used. Table 2 shows the natural gas and electricity consumption for each of the nine counties for the year 1978. Contra Costa County is the largest user of natural gas with 27% of the region's consumption while Santa Clara leads in electricity with a 24.7% share.

Electricity is generated using other forms of energy. As shown in Figure 1, PG&E uses a certain amount of natural gas for electrical production. Other energy forms used included hydroelectric power, geothermal, and residual and distillate oil (PG&E 1980). The quantities of these energies and the amount of electricity produced by them are recorded by PG&E for the service area. Additionally, the Company purchases an amount of electricity from other utilities and these are also recorded. These data are also available from PG&E.

On the State level, the California Energy Commission collects data on supplies of natural gas, electricity and petroleum. This is summarized in Table 1. The sources of these data are primarily utilities and refiners. Quarterly tabulations are prepared which present the energy balance for the State as a whole (CEC, 1979a). Energies coming into, produced and consumed within, and leaving the State are separated into three major classes: electricity, natural gas and petroleum and petroleum products. These are further broken down into end use sectors for natural gas and electricity. For the petroleum class, data are available for crude oil, gasoline, aviation fuels and industrial grade oils.

Another very useful breakdown of the data deals with crude oil supplies. These are tabulated by state, domestic and foreign sources. This additional disaggregation helps to define the stability of each source.

The California State Board of Equalization (CBE) collects a tax on gasoline sold within the State (CBE, 1980). This tax is paid by each refiner/supplier and is not disaggregated to the county level. However, the approximate gasoline use in the region can be estimated from this data by assuming gasoline usage to be proportional to vehicle registration (California Department of Motor Vehicles, 1979). In Figure 5, the State and regional gasoline use calculated by this method is shown. The nine-county region uses roughly 22% of the state total. In terms of Btu, this is equal to 327 trillion Btu in 1978 which is comparable to the region's use of natural gas.

For the San Francisco Bay Area, the consumption of natural gas, electricity and gasoline totaled about 755 trillion Btu in 1978. This represents roughly 85% of the fuels supplied to the area (CEC, 1979a) for consumption. The bulk of the remainder was used in aviation as jet

TABLE 2

SUMMARIES OF NATURAL GAS & ELECTRICITY CONSUMED BY COUNTIES IN 1978

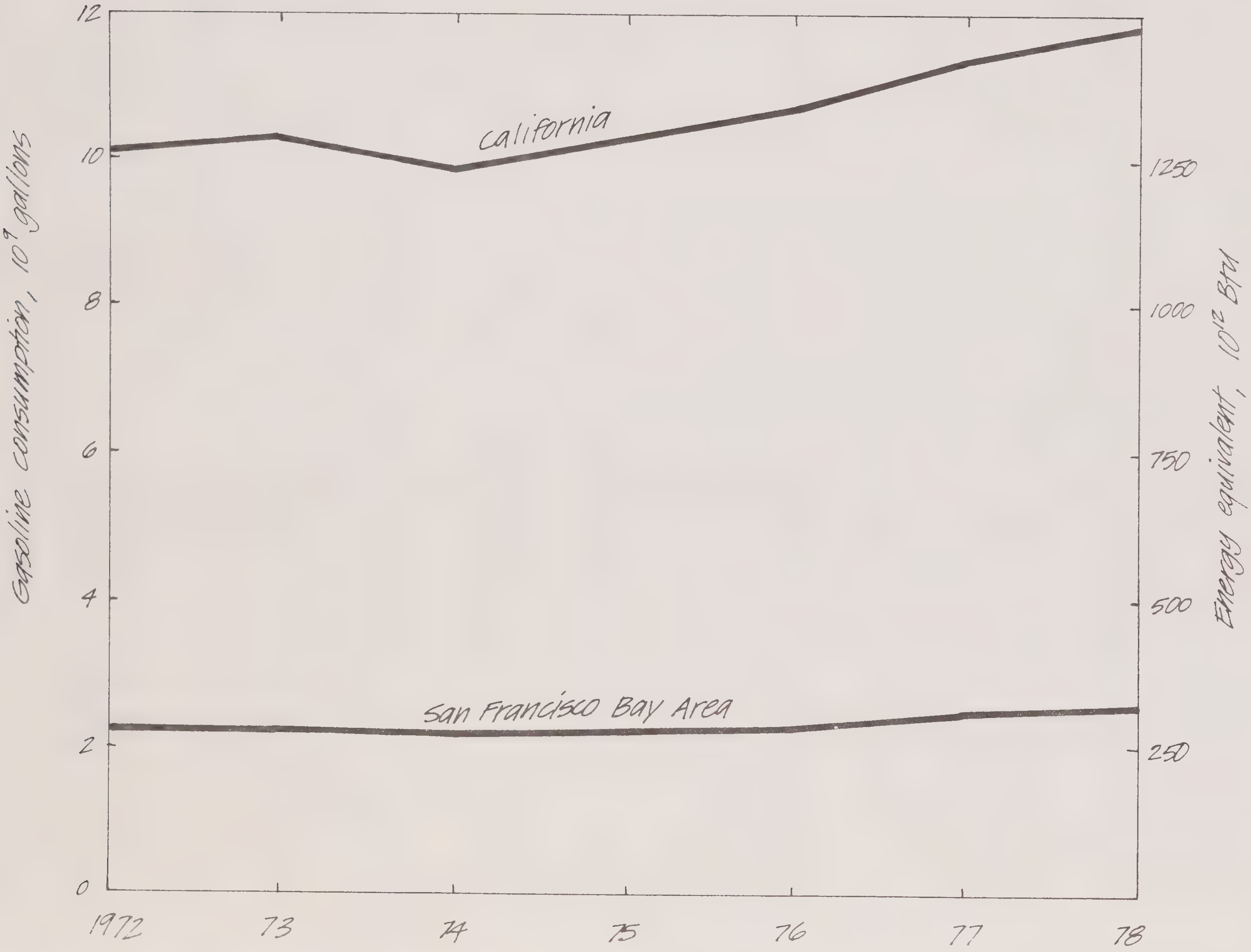
County	Natural Gas			Electricity		
	10^6 Therms[1]	10^{12} Btu[2]	% of Regional Supply	10^6 KWH[1]	10^{12} Btu[3]	% of Regional Supply
Alameda	675	67.5	20.8	6702	22.9	22.0
Contra Costa	877	87.7	27.0	5731	19.6	18.9
Marin	97	9.7	3.0	986	3.4	3.3
Napa	40	4.0	1.2	459	1.6	1.5
San Francisco	356	35.6	11.0	3501	11.9	11.5
San Mateo	285	28.5	8.8	2789	9.5	9.2
Santa Clara	650	65.0	20.0	7478	25.6	24.7
Solano	168	16.8	5.1	1339	4.6	4.4
Sonoma	103	10.3	3.1	1390	4.7	4.5
Total	3251	325.1	100.0	30375	103.8	100.0

[1] Source: Pacific Gas and Electric Company

[2] Conversion Factor: 1 therm = 100,000 Btu

[3] Conversion Factor: 1 KWH = 3413 Btu

Figure 5. Gasoline consumption trends, 1972-8



Sources: California Board of Equalization and California Department of Motor Vehicles

fuel and by the oil refineries which consume a portion of their crude supplies to run their facilities.

Yearly energy balances, energy input, production, consumption and output, are prepared by the U.S. Department of Energy for each state and for the nation (U.S. DOE, 1979a). These data are reported by the following energy use sectors: electric utility, residential, commercial, industrial and transportation. For each of these, the yearly consumption of various energy supplies are tabulated. These data are transmitted to DOE by state agencies and major energy producers.

Energy Supply Projections

Each major energy supplier and various government agencies perform projections. In the case of a utility, arrangements often have to be made many years in advance to secure contracts for certain fuels. Using supply projections for each energy form, the utility can pursue contracts based on fuel availability. Government agencies need an idea of fuel availability in order to perform planning functions and to prepare contingency plans for energy shortages.

A summary of the available energy projections applicable to the Bay Area is shown in Table 3. It lists the organizations which performed the projections and some of the areas covered.

PG&E prepares projections for natural gas supplies (PG&E, 1979c) and for energy sources that can be used for electrical generation (PG&E, 1979b). These cover a 20-year period. Part of the future supplies are guaranteed by long-term contracts or through direct ownership as are their coal supplies. The remainder of the projected supplies are based on completion of various projects such as the proposed Alaskan natural gas pipeline, commercialization of new technology, and the availability of energy sources at the state, national and international level. Projections for these more uncertain energy supplies are based on those prepared by industry groups and by government agencies. From these data, PG&E distills the probability that they will be able to secure a portion of the supplies.

The California Public Utilities Commission (CPUC) regulates the intrastate flow of natural gas. They have prepared a study to assess California's natural gas supply for a 20-year period starting in 1978 (PUC, 1978). Their data sources included utility information on their guaranteed and projected supplies, and government agencies. Differences between the PG&E and the PUC studies arise primarily from assumptions on the probability of the non-guaranteed natural gas supplies.

A primary function of the CEC is to prepare a Biennial Report which views the projected energy situation for the state for a 20-year period. The 1979 Biennial Report is currently in the final stages of preparation (CEC 1979b,c,e,f). The report has both supply and demand projections. For the former, an energy scenario is developed for all classes of energy: natural gas, electricity and the availability and mix of fuels to generate it (CEC 1979g,h), and fossil fuels (CEC 1979d,e). Their

TABLE 3

SUMMARY OF ENERGY SUPPLY PROJECTIONS

Data Source	Projection Area	Projection Period, years	Energy Forms		
			Electricity	Natural Gas	Petroleum
PG&E	System-wide (Northern & Central California	20	X	X	
California Public Utilities Committions	California	20		X	
California Energy Commission	California	20	X	X	X
U.S. Dept. of Energy	U.S. & California	20	X	X	X

data sources are again industry sources and government agencies such as the PUC. No disaggregation of the data is available for the Bay Area.

The DOE also prepares projections, usually for a 20-year period, that rely heavily on their own energy technology and supply development programs in addition to industry sources. All energy sources are encompassed in the DOE reports (U.S. DOE, 1979b,c,d). Their greatest value is at the national level where a broad view of the future supply to the country is needed.

As a rule, projections rarely agree. Each group has their own methodologies for forecasting energy supplies. Most of the differences lie in the probabilities used in assessing fuel availability. An industrial perspective is different from a governmental perspective, and the State's perspective is different from that of the federal government's. The value of such projections is that potential problems can be anticipated, and decisions can be made to alleviate or at least minimize them. From a local and regional perspective, the projections made at the State and national levels are often difficult to apply to a local decision or policy. The Phase II effort will include the development of a set of energy supply projections appropriate to the Bay Area.

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REGIONAL ENERGY-ECONOMIC INFORMATION SYSTEM

A key element in designing policies to minimize the consumption of energy resources requires development of a system that provides accurate information about the pattern and quantity of energy use in the residential, commercial, industrial, and transportation sectors. Each region of the country has its unique mix of conditions affecting the consumption of energy resources. National energy policies can be effectively implemented at the local and regional level through a process that considers both the mix of energy use and the uniqueness of development patterns that affect the mix. Within this context, ABAG is developing a Regional Economic-Energy Information System (REEIS) for the San Francisco Bay Region.

A review of existing energy demand forecasting models was conducted to determine the state of the art and whether any existing models would satisfy these objectives. The results of the review are described in Appendix A. No existing model was considered immediately applicable to the Bay Area in context of ABAG's existing modeling system, although numerous insights were gleaned for the design of a regional energy demand forecasting system.

The existing ABAG modeling system provides regional data on demographic, economic and environmental conditions. For example, information is available on population, employment, land use, transportation, housing, air and water quality. Historic information serves as a basis for making projections of future trends. These baseline conditions, in turn, provide the data for conducting impact assessments of the future. Explicit incorporation of energy factors into the ABAG modeling system will provide policy makers with an additional tool and valuable information on which to make decisions affecting the Bay Area's physical growth, environment and economy. Specifically, the objectives of this task are:

a) to develop a policy-sensitive modeling system which decision-makers can use to understand the relative demand for energy resources in the residential, commercial, industrial, and transportation sectors;

b) to provide energy, environmental and economic resource planners with a system that estimates the potential energy savings from technological advances, requirements for efficiency standards, behavior changes due to market conditions (e.g., rising energy costs) or a combination of the above; and

c) to provide insight into regional energy impacts of environmental regulatory programs at the industry specific level, and to raise the public consciousness to the energy impacts of such regulatory requirements.

Model Description

The ABAG REEIS is designed as an interactive computer based simulation system providing energy, economic and demographic information at the regional level. The energy component provides aggregate energy consumption information in Btu's for the residential, commercial, transportation, and industrial consuming sectors. The data for the industrial energy consumption model are disaggregated to a level consistent with the Standard Industrial Classification (SIC) categories in the economic model to facilitate compatibility and consistency. The economic model provides gross output information, employment requirements, personal consumption expenditures, and per capita income data. The demographic model interacts with the economic model and provides data on population and labor force. The REEIS is a first-generation modeling system for energy modeling in the San Francisco Bay Region. Figure 6 shows the relationships between the components of the system and provides an overview of how the sub-models interact. A detailed technical description of the REEIS is given in Appendix B.

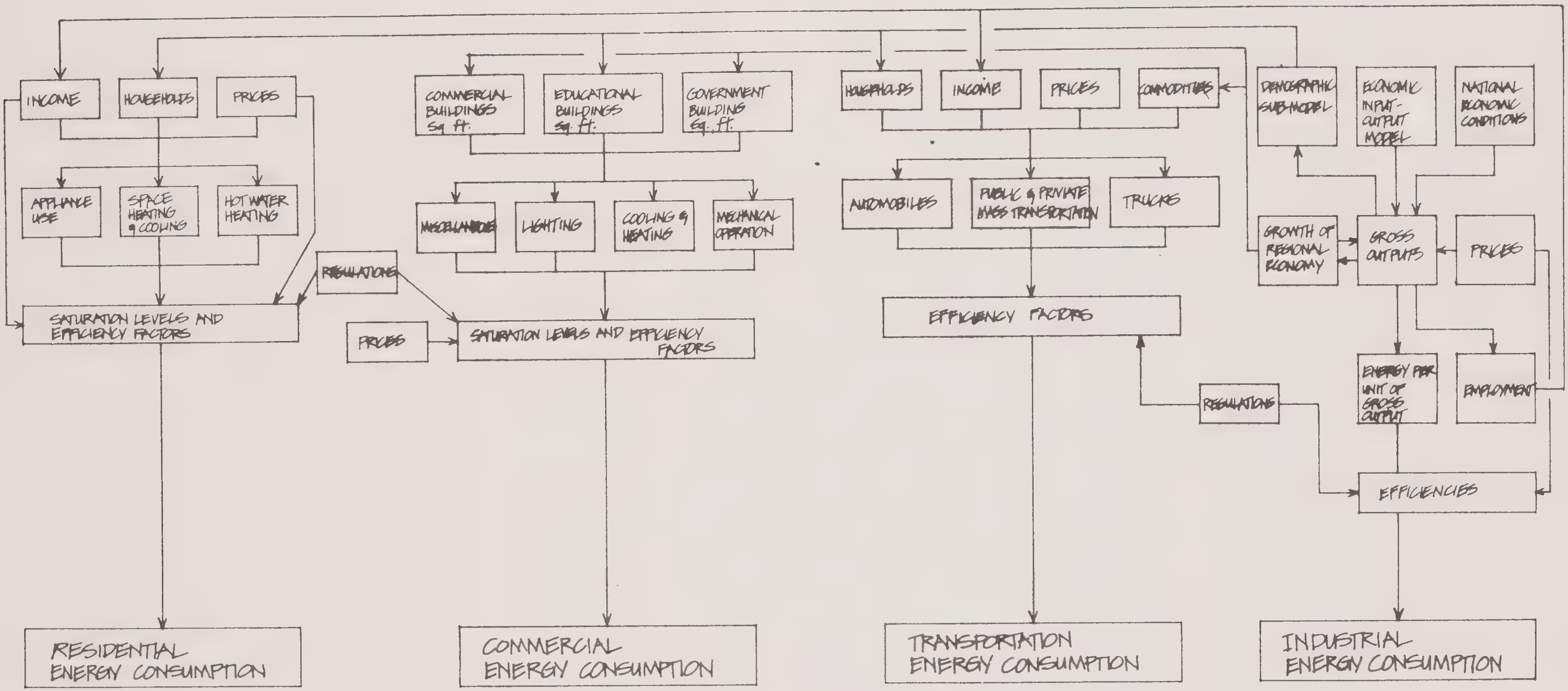
Model Applications

Recent national and international events have brought about changes in governmental policies regarding energy resources consumption, environmental protection and economic development. As inflationary pressures stimulate price increases and energy resources diminish, new trends can be expected in supplies, demands, transactions and impacts. Policy changes at all governmental levels are likely in response to rapidly changing market conditions and resource constraints.

One fact has become increasingly clear; historical data alone are not sufficient to forecast future trends. Structural relationships underlying past trends will be substantially changed by modification in economic, energy and environmental policies. Both short and long term behavior changes in public markets and private investment can be anticipated. Added scrutiny will be given to current environmental policies--efficiency, effectiveness, cost-benefit, and other socio-economic impacts.

The modeling approach in REEIS will provide a systematic methodology for assessing future policy changes and their likely impacts. It is designed to permit system flexibility in providing broad assessments of market and policy induced changes on the regional consumption of energy in transportation, residential and commercial activity and the economy.

Figure 6. **REGIONAL ENERGY-ECONOMIC INFORMATION SYSTEM**



LOCAL GOVERNMENT ENERGY PROGRAMS

The development of a regional energy plan is based on the expectation that Bay Area cities and counties will play an important role in its implementation. The basic objectives of using energy resources more efficiently and of developing alternative sources are to strengthen the Bay Area's position in an increasing tight energy situation. These objectives are consistent with local government's desires to increase their self-sufficiency and preserve the quality of life in their communities.

Local governments control and manage their internal operations and have the power to influence private sector activities through their police power. Thus, they are in the position to alter the energy supply and demand profile within their community. These powers may be used to effect energy conservation or to promote local generation of energy. Yet the commitment and ability of local governments to carry out energy programs will depend on a number of factors--political, economic, and social. Furthermore, the benefits and costs for energy programs will vary according to particular local situations.

Many local governments in the Bay Area and elsewhere in the country have valuable experience in energy planning and management that others can benefit from. Their successes and failures should promote an understanding of what works for and is acceptable by local governments.

An early task in preparing ABAG's regional energy plan was to overview the region's progress in implementing local energy programs. A telephone survey was conducted of selected Bay Area cities and counties to compile information on existing local energy programs.

All nine Bay Area counties and 19 cities were contacted. In addition, eight cities, counties, and COG's elsewhere in California and the country were interviewed by phone. Description of the energy activities encountered are contained in Appendix C. The survey was not intended to be all inclusive and, therefore, cities doing current work in energy may have been overlooked.

In addition, a master list of energy conservation measures was drawn together from existing sources. This list is not restricted by consideration of feasibility, acceptability, cost, implementing agent, or applicability to local circumstances. It is meant to illustrate the wide range of possibilities for local action in energy conservation. An assessment to determine the most favorable measures for Bay Area cities and counties will be done in Phase II.

Survey of Existing Local Government Energy Activities

The selection of cities contacted in our survey was biased toward those that were known to have begun energy planning and management (Marin Citizens for Energy Planning, Energy Policies and Programs of California Cities and Counties: A Survey, 1977; and phone conversation with Lance Muller, Conservation Division, California Energy Commission). The depth and extent of their experiences varied considerably, however. The list of cities and the nine counties contacted is shown in Table 4.

In this table summarizing local government energy conservation, the broad headings--planning, internal operations, and private--reflect normal assignment of roles within local governments, type of local power, and implementing responsibilities. Information on a particular local government's energy activities was often dispersed among different departments.

An initial conclusion about existing local energy programs is the consistent lack of centralization or coordination within the local government departmental structure. By and large, the energy activities of a city or county have emerged along logical departmental lines without a well-defined city-or county-wide approach. There were a few outstanding exceptions to this rule.

Of those contacted, most counties and more than half of the cities have set up a committee structure specifically for energy planning. However, there is a tremendous variety in size, composition, relationship to decision-makers, and influence. Local elected bodies, in some cases, have established subcommittees or advisory commissions to provide guidance on energy planning and implementation. At the staff level, inter-departmental task forces serve to communicate energy program activities within local governments. Some counties are attempting to coordinate their own efforts with city programs or to provide assistance where possible.

Functionally, these committees and task forces may adopt a broad outlook for energy planning and management, others have chosen to focus on a particular aspect, such as ordinance revision or on internal conservation measures. Several cities indicated frustration at the low level of funding and staffing allocated to service these committees.

About half of the cities and counties surveyed are in some phase of preparing an energy element or plan; only two cities have adopted elements. Others indicated that budget constraints prevented their agency from doing local energy planning. Some cities and counties without elements noted that other general plan elements, such as land use and transportation, contain energy conservation policies.

Almost without exception the cities and counties had taken steps within their own local operations to use energy more efficiently. Where energy conservation and cost savings go hand-in-hand, local governments are more willing to change practices or make equipment and facility

Table 4 summary of energy conservation measures in the Bay Area*

Local government	Planning: Energy Element	Planning: Energy Committee	Internal operations: Heating, ventilation and air conditioning	Internal operations: Building and street lighting	Internal operations: Vehicle fleet	Private: Regulation	Private: Outreach and public education
COUNTIES							
Alameda	◒	●	◒	◒		◒	
Contra Costa			●	●	●		
Marin	◒	●	●	●	●	◒	◒
Napa	◒	●	●	●	◒	◒	◒
San Francisco	◒	●	◒	◒		◒	◒
San Mateo		●	●	●	●	◒	◒
Santa Clara	◒	●	●		●	◒	◒
Solano		●	●			◒	
Sonoma		◒	●	●	●	◒	◒
CITIES							
Alameda	◒	●	◒	◒		◒	●
Berkeley	◒	●	●	●		◒	
Fairfield	◒	◒	●	●	●	◒	◒
Hayward				●	●		
Livermore	●	●	●	●		●	
Martinez				◒		●	
Mountain View			●	●	●		
Napa	◒	◒	●	●	●	◒	
Oakland	◒		●	●	●		●
Palo Alto	●	●	●	●	●	◒	●
Petaluma			●	●		◒	
Pinole		◒	◒	●	◒		
Redwood City				●			
Richmond		●	●	●	●		
San Jose	◒	●	●	●	●	◒	
San Leandro	◒	●	●	●			
South San Francisco		●	●	●	●		
Sunnyvale	◒	●	●	●	●	◒	
Vallejo		●	◒	●	◒	◒	◒

● Approved, adopted, or implemented

◒ some level of activity, or being considered

* Based on telephone interviews of selected cities and counties conducted during December 1979. This summary is not intended to represent an exhaustive list of Bay Area energy conservation activities.

modifications. The "internal" conservation measures most commonly mentioned were changes to heating, ventilation and air conditioning equipment and lighting reduction. A number of cities and counties were going to smaller agency cars and fuel savings maintenance. Many cities have relamped street lights to high or low pressure sodium, some with considerable cost savings as a result.

Local governments have been less ready to apply their regulatory powers for the purposes of forcing private sector energy conservation. There are only a few examples of formally adopted local ordinances that require specific energy conservation measures.

However, many cities and counties are considering such regulatory measures. Some of these measures have already been proposed but have not been adopted by local elected bodies. There are several examples of local planning staffs that are informally including energy considerations in their review of permit applications. The measures that are most often mentioned as feasible for local implementation through the regulatory process are insulation and weatherization, restrictions on water heating, and siting and orientation of structures.

Local governments expressed some reluctance to impose new regulations; some actually stated a preference for reliance on voluntary compliance through public education. Difficulty and cost of enforcing new codes also poses problems, particularly when applied to existing structures.

There were few examples of active, highly visible public outreach programs within local governments to promote energy conservation. This seems to be one of the less well developed aspects of local energy programs.

Energy Conservation Activities of Pacific Gas and Electric Company

Although PG&E's conservation activities are not the direct subject of investigation in this program, PG&E is the largest energy supplier in the Bay Area, and it's conservation programs have been greatly expanded in recent years, with a total budget of $80 million for 1980 (PG&E, 1979). These programs are mentioned here and summarized in Appendix C for the sake of completeness.

Pacific Gas and Electric Company's planned conservation activities for 1980 include six customer related conservation programs and seven other conservation activities. Customer related conservation programs are: (1) Weatherization Program, which promotes insulation and other building envelope improvements through financing, home audits, and incentives; (2) Appliances and Devices Program, which focuses on consumer awareness of appliance efficiency; (3) Energy Conservation Homes Program, which encourages builders to exceed State standards for energy efficient construction; (4) a multi-faceted Commercial-Industrial-Agricultural Program; (5) Solar Program of demonstration and monitoring projects, and incentives; and (6) General Awareness Program, which conveys the conservation message through consumer education and advertising campaigns.

In addition to these programs, the seven other conservation activities are: (1) energy conservation research and development, where the company tests and monitors emerging conservation products and concepts; (2) load management and load management research and development, which conveys the need for off peak usage by residential and non-residential customers; (3) development of energy alternatives, such as cogeneration and solid waste recovery; (4) energy from biomass; (5) conservation voltage regulation, which involves voltage surveillance and feeder testing; (6) conservation programs at company facilities; and (7) a steetlight conversion program, which has, as its goal, conversion of the streetlights in PG&E territory to high pressure sodium vapor lights.

Options for Local Government Energy Conservation

Based on the survey of local government energy activities and on a literature search, a master list of local energy conservation measures was compiled. Sources that proved particularly valuable were:

- Technical Report #3: Energy Options for Marin County, First working draft November 1979, Sedway/Cooke for Marin County Comprehensive Planning Department.

- Proposed Energy Policy for Portland, Discussion Draft.

- Review of Energy Task Force Report on Energy Conservation and Management in County Government Facilities, General Services Agency, Santa Clara County, 9/1/78.

- Draft Air Quality Maintenance Plan, Association of Bay Area Governments, December 1977.

The measures included in Table 5 are intended to be ones that a local government has the authority to implement. The list is lengthy and it is recognized that many factors will determine appropriateness of specific energy conservation measures in any given community; it was developed to illustrate the range of opportunities available to local governments.

The measures are categorized by energy demand sector. Each energy conservation measure within a sector is aimed toward reducing the energy consumption that is characteristic of that sector. A city or county may implement measures in these sectors through education, incentives, or mandatory actions aimed at promoting or requiring specific energy conserving actions. The implementation techniques are listed by sector and do not correspond to specific measures.

TABLE 5

OPTIONS FOR LOCAL GOVERNMENT ENERGY CONSERVATION

Implementation Technique By Sector / Energy Conservation Measures By Sector	Educational	Incentive	Mandatory
Residential Sector (Owner-Occupied and Investor-Owned) Space Heating and Cooling - Manually set back thermostat during the day and at night (new and existing homes) - Install automatic thermostat set back device (new and existing homes) - Weatherstrip doors and windows (existing homes) - Insulate ceilings with accessible attics to R-19 (existing homes) - Insulate floors over unheated attics or crawl spaces to R-11 (existing homes) - Insulate walls to R-11 (existing homes) - Install storm windows (existing and new homes) - Insulate space heating ducts located in unheated areas (existing homes) - Maintain furnace efficiency by cleaning filters and adjusting burners in all forced air furnaces (existing and new homes) - Replace pilot light in gas furnaces with electric ignition device (existing and new homes) - Heat houses selectively by zone (existing and new homes) - Build multiple unit housing to increase common walls and floors/ceiling, thereby reducing number of surfaces exposed to weather (new homes) - Orient homes to take advantage of solar heat gains in winter and to reduce summer solar heat gains (new homes) - Install active solar space heating systems (existing and new homes) - Provide shading for windows on east, west, and south sides of houses to reduce solar heat gains in summer (existing and new homes) - Fireplace heat extractors - Attic Ventilation retrofit Water Heating - Wrap insulation around hot water tank - Lower hot water tank temperature settings - Install flow restricters in shower heads - Wash clothes in cold water - Replace gas water heater pilot lights with electric ignition devices - Install solar assisted hot water heating systems - Use insulation blankets on swimming pools and hot tubs - Install water heater timing device Lighting - Replace incandescent lamps with fluorescent lamps - Replace existing bulbs with lower wattage bulbs - Turn off lights when not in use - Substitute day lighting for artificial lighting	o Unified educational and informational material o Marketing activities o Supplemental material to utilities o Programs for lenders, homebuilders, real estate agents o Demonstration houses o General media ads on need for conservation o Seminars for building owners and managers o Mailings with City business license application o Home energy audits	o One stop retrofit package o Low interest loans o Tax credits o State mandated weatherization programs o Zero net outflow of capital o Tax on energy consumption over established limits o Material to market conservation to new tenants	o Require retrofit to cost effective standard before house can be sold o Building code modifications for new construction

TABLE 5

OPTIONS FOR LOCAL GOVERNMENT ENERGY CONSERVATION

Implementation Technique By Sector / Energy Conservation Measures By Sector	Educational	Incentive	Mandatory
<u>Residential Sector</u> (continued) Appliances - Replace gas range pilot lights with electric ignition devices - Reduce the use of appliances and improve the energy efficiency of those which are essential - Use solar clothes dryer (clothesline)			
<u>Commercial Sector</u> Space Conditioning - Restore existing HVAC (heating, ventilation, and air conditioning) equipment to maximum efficiency; periodically reinspect to maintain efficiency - Reduce hours of operation of HVAC equipment - Install automatic thermostat setback devices - Institute load management programs - Install storm windows - Increase insulation of exterior structure surfaces - Reduce outside air ventilation rate - Orient structure to reduce summer solar heat gains and to increase winter solar heat gains (new construction) - Increase natural ventilation during summer months - Install active solar space heating system - Reduce ceiling heights Water Heating - Reduce temperature setting on water heating system - Reduce hot water consumption - Use waste heat from space heating system to preheat water - Install solar hot water heating system Lighting - Reduce use of lighting for advertising signs - Reduce lighting in nonwork areas - Replace gang lighting with task lighting - Limit size of floor area illuminated by individual light switches - Replace artificial lighting with natural lighting - Replace incandescent lighting with flourescent lighting General - Install individual electric and gas meters for each tenant of a commercial structure	o Seminars by trade goups o Mailings with business license application o Energy Newsletter o Individual building audit and consultation	o Public recognition o Loan pool o Business assistance grants and loans o Tax credits o Tax on commercial energy use	o Require energy audit withing specified time period and identify possible actions o Require prescribed actions when building is sold or remodeled o Building code modification for new construction o Restrictions on outdoor advertising lighting

TABLE 5

OPTIONS FOR LOCAL GOVERNMENT ENERGY CONSERVATION

Energy Conservation Measures By Sector / Implementation Technique By Sector	Educational	Incentive	Mandatory
Industrial Sector Many of the measures listed under commercial sector would be applicable to industrial. General actions are listed below for industry. - Institute good housekeeping practices to eliminate energy waste - Use optimally efficient processes, equipment, pumps, and motors - Maximize use of recycled materials - Recover waste heat to provide space heating to adjacent commercial and residential structures through district heating - Recover waste heat for cogeneration of electric power	o Mailings with City business license application o Seminars for each group o Energy use audit and consultation	o Public recognition o Municipal bond loans for major investment o Accelerated depreciation on energy-inefficient equipment o Business assistance grants and loans o Business assistance programs for new energy trades and technology o Investment tax credit for energy efficient equipment & measures o Tax on energy use	o Require energy audit within specified time period and identify possible action
Institutional Sector Vehicles - Use more energy efficient vehicles - Reduce vehicle travel - Initiate drivers energy efficient training program Buildings/Facilities - See conservation actions for residential and commercial sectors - Perform energy audits and implement energy management programs - Establish energy budgets for discrete facilities - Utilize life-cycle costing in outfitting facilities with major energy consuming equipment Operations - Implement resource recovery system for paper products - Establish departmental energy budgets and conservation goals - Designate energy conservation co-ordinator for in-house operations; initiate employee education programs	o Mailing with business license when applicable o Seminars for each group o Use as dissemination point for general information to public	o Public recognition o Loan pool o Business assistance grants and loans o Tax credits for tax-paying organizations o Financial assistance for non-taxpaying institutions which cannot otherwise afford to comply with requirements	o Same as commercial o Accreditation requirements for hospitals and nursing homes

TABLE 5

OPTIONS FOR LOCAL GOVERNMENT ENERGY CONSERVATION

Energy Conservation Measures By Sector / Implementation Technique By Sector	Education	Incentive	Mandatory
<u>Transportation Sector</u> - Improve traffic flow - Reduce peak-period traffic volume - Management of auto access - Increase cost of auto use - Increase transit ridership - Encourage pedestrian mode - Encourage bicycle mode - Lower vehicle speeds	o Advertising and information campaigns	o Traffic engineering improvements o Off-peak and off-street freight loading o Better enforcement of parking regulations o Limited number of parking spaces o Prohibiting on-street parking during peak hours o Area license o Auto free zones o Road pricing o Increased parking costs o Minimum parking fees at large shopping centers o Elimination of free employee parking o Increased transit availability and operating efficiency o Reduced transit fares o Improved transit comfort o High-occupancy vehicle lanes o Provide pedestrian amenities o Provide bicycle facilities o Preferential parking for carpools o Fuel-efficient vehicle speed limits	o Computerized traffic control system

TABLE 5

OPTIONS FOR LOCAL GOVERNMENT ENERGY CONSERVATION

<table>
<tr><th>Implementation Technique By Sector / Energy Conservation Measures By Sector</th><th>Education</th><th>Incentive</th><th>Mandatory</th></tr>
<tr><td>Land Use Sector

- Extend new development only to those locations with existing sewer and water service or sewer and water service committed in capital improvement programs
- Develop unimproved land within urban service areas where urban services exist or are committed in capital improvement programs
- Improve highway, street, road and transit systems consistent with local actions to stage land development
- Increase housing and job opportunities in existing urbanized areas by encouraging public and private rebuilding into compatibly mixed commercial, industrial and residential land uses
- Encourage "infill" development of bypassed vacant land within urban service areas
- Develop at higher densities within service areas where existing or committed urban service capacities, including transit, can support the higher densities
- Improve the balance of jobs and housing in jurisdictions throughout the region to reduce the necessity for long distance home-to-job travel
- Mix residential/commercial and industrial development in communities throughout the Bay Region
- Discourage new large-scale land development projects that are exclusively commercial, industrial or residential, unless such projects clearly demonstrate that they improve the overall balance of jobs and housing in that city, county, or subregion.</td><td>o Advertising and information campaigns</td><td>o Revisions of general plan, zoning and subdivision ordinances, EIR guidelines to encourage energy conserving land use patterns</td><td>o Revisions of general plan, zoning and subdivision ordinances, EIR guidelines to require energy conserving land use patterns</td></tr>
<tr><td><u>Local Government - Internal Energy Conservation and Management</u>

Transportation

- Compact Cars
- Fuel Economy Rules
- Driver checklist
- 50 mph speed limit
- Used oil recycling
- Gather information by telephone
- Gasoline Budgeting
- Matching job and vehicle
- Replace Gasoline Vehicles with Diesel Vehicles
- Radial tires
- Carpool program
- Preferential carpool parking
- Shuttle service</td><td colspan="3">o Local government allocation of personnel and funds toward equipment, facility and operational modifications</td></tr>
</table>

TABLE 5

OPTIONS FOR LOCAL GOVERNMENT ENERGY CONSERVATION

Energy Conservation Measures By Sector \ Implementation Technique By Sector	
Local Government - Internal Energy Conservation and Management (continued) Transportation (continued) - Expand county driver's course - Encourage use of public transportation - Elimination of air conditioning and other power accessories Building Operations - Decorative lighting - Non-work area lighting - Work area lighting - Lighting redesign - Group tasks that require same - Lighting level - Selective lighting - Section lighting - Custodial work hours - Heat of light removal - Grouping of tasks that require same ventilation levels - Maximum building heating temperature - Minimum building cooling temperature - Equipment shutdown - Life cycle costs - Emergency generator fuel - Hot water circulating system shutoff - Static capacitors - Energy efficiency and interior decoration - Off-peak use Water Conservation - Restricted watering - Night watering - Moisture test - Manual watering - Lawn mowing - Inspection of irrigation systems - Water runoff - Washing of surfaced areas - Washing county vehicles - Water use in pools and fountains - Water flow restrictors	

TABLE 5

OPTIONS FOR LOCAL GOVERNMENT ENERGY CONSERVATION

Implementation Technique By Sector / Energy Conservation Measures By Sector	
<u>Local Government - Internal Energy Conservation and Management</u> (continued)	
Paper Recycling	
- Waste paper recycling	
- Paper recycling report	
- Waste pater sorter	
New Buildings	
- Alternate Power assessment	
- Optimum solar orientation	
- Optimum wind utilization	
- Work area lighting	
- Non-work area lighting	
- Decorative lighting	
- Group tasks requireing same light level	
- Selective lighting	
- Section lighting	
- Heat of light removal	
- Grouping tasks requiring same ventilation levels	
- Maximum building heating temperature	
- Minimum building cooling temperature	
- Equipment shutdown	
- Life cycle costs	
- Hot water circulating system shut-off	
- Static Capacitors	
- Improved chiller efficiency	
- Energy efficiency and interior design	
- Off peak use	
Street Lighting	
- Replace existing lights with more efficient ones	
- Use most efficient lights in new development	
- Remove lights where possible	
- Timer controlled lights to shut off when not needed	

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County of Sonoma, "Report to Board of Supervisors on Questions Concerning County Energy Conservation Program and Report on Community Network Contract Proposal for Energy Conservation Component", County of Sonoma, Office of County Administration, November 20, 1979, Santa Rosa, California.

This section reports the Phase I results of estimating the direct incremental energy impacts of the 1979 Bay Area Air Quality Plan (BAAQP). The overall goal of this task is to quantify the direct incremental energy impacts of implementing the policies and actions in the 1979 BAAQP. Direct energy impacts are the primary or first-order energy costs and benefits experienced by the pollution source to which the air pollution controls are applied. For example, the energy impacts of using available control technology on existing stationary hydrocarbon sources will be examined; what will not be addressed is the energy used to manufacture the technology, transport it to the hydrocarbon source, install the equipment, maintain the equipment, etc. Ideally, the goal is to quantify the energy impacts in terms of the following ratio: energy units consumed or saved/units of pollutant emissions controlled.

The objectives in Phase I are to collect the data needed for the energy impact analyses and to develop the methodology for quantifying the energy impacts. Phase II will consist of performing the actual impact assessment using the data and methodology from Phase I.

This section discusses the policies selected for energy impact analysis, the data collected for the study to date, the data needed but not yet collected, and the data needed but which probably doesn't exist. In addition, the methodology developed to quantify the energy impacts, as well as uncertainties in the methodology are discussed.

Air Quality Plan Policy Actions

The policy actions of the 1979 BAAQP were screened to identify three types of actions:

- o those with significant energy impacts;
- o those for which the energy impacts have been assessed in previous studies;
- o those with insignificant energy impacts.

The following policy actions were identified as having significant energy impacts (ABAG, 1979):

- o RACT - this policy action calls for the use of available control technology on existing stationary hydrocarbon sources; available control technology refers to an emission limitation based on the maximum degree of reduction of hydrocarbons emitted from or which results from any emitting facility, which the permitting authority, on a case-by-case basis, taking into account energy, environmental and economic impacts and other costs, determines is achievable for such facility through application of available methods, systems and techniques; as interpreted by the Bay Area Air Quality

Management District (BAAQMD), this policy is roughly equivalent to the use of reasonably available control technology (RACT).

- NSR - calls for continuing the new source review (NSR) procedure, which is the review of new or modified industrial facilities to allow for a reasonable level of growth consistent with the requirements of the Clean Air Act Amendments; new or modified hydrocarbon sources are to use technology to produce the lowest achievable emission rate.

- I/M - calls for implementing a Statewide vehicle inspection and maintenance (I/M) program for light and heavy-duty vehicles.

- Parking - calls for preferential parking for carpools and vanpools.

- HOV Lanes - calls for supporting the development of high-occupancy vehicle (HOV) lanes and/or ramp metering on selected freeway segments when justified on an individual project basis.

- Ride-Sharing - calls for the provision of more ridesharing services such as jitneys and vanpools, and the development and monitoring of objectives for gauging the desirable expansion rate of these services.

- Bicycle Systems - calls for the development of more extensive and safe bicycle systems and storage facilities and the development and monitoring of objectives for gauging the desirable expansion rate of the systems.

Phase II of this study will focus on gathering data and developing the methodologies needed to estimate the energy impacts of the above policy actions. Energy impact assessments were performed in previous studies for two policy actions.

These policy actions are described below; the appropriate impact assessment study is referenced for each policy action. Because Phase I is concerned with data collection and methodology development, these policy actions will be excluded from this report; however, the results of the energy impact analyses will be discussed in Phase II.

- Exhaust Emission Controls - calls for implementing more stringent light-duty and heavy-duty exhaust emission controls, reducing emissions 50% below 1977 prescribed levels; energy impact analysis done in AQMP Tech Memo 8 (ABAG, 1977).

- Transit Improvement - calls for the pursuing of a threefold transit improvement strategy:

- MTC is to adopt transit service improvement objectives;

- o identify the need for additional transit services

- o Federal and State governments are encouraged to provide the necessary funding support for transit improvements; energy impact analysis performed in AQMP Tech Memo 15 (ABAG, 1978).

The remaining policy actions in the 1979 BAAQP were eliminated from this study, either because they would not have significant energy impacts or because they are to be implemented in the distant future and therefore can't be accurately described at the present time.

Data Collected

The data required for estimating energy impacts were collected for a portion of the sources covered by the RACT Policy Action and all sources covered by the I/M Policy Action.

RACT Energy Impacts. To estimate the direct incremental energy impacts of requiring the use of RACT, four types of data are needed:

- o existing stationary hydrocarbon source types in the Bay Area;

- o description of available control technologies (RACT) for each source type;

- o percentage of each source type using a particular RACT;

- o energy demands of the RACT.

Data describing RACT and percent usage were not available for all hydrocarbon sources. Table 6 summarizes the data collected to date. The sources listed in Table 6 represent approximately 75 percent of the total 1975 stationary hydrocarbon emissions (Storey, 1979).

The data in Table 6 indicate that few of the RACT's have significant energy impacts. The major concern being addressed in this study is whether or not the air pollution control measures recommended in the 1979 BAAQP will result in significant increased energy consumption over the "no-controls" situation. For the sources listed in Table 6, the energy demands of the respective RACT's are not a real concern. These data do not reflect secondary or hidden energy costs of the RACT's, e.g., manufacture of the RACT, maintenance, etc.

I/M. The data required for estimating the energy impacts of implementing a vehicle inspection and maintenance (I/M) program were obtained from reference EPA, 1979.

Table 7 summarizes these data. The primary source of data for estimating the energy impacts of I/M was the EPA Portland study, which is a detailed study of a real I/M program. The energy impacts of I/M vary with the model year of the vehicle and the degree of mechanic training.

TABLE 6
SUMMARY OF AVAILABLE DATA FOR ESTIMATING
ENERGY IMPACTS OF USING REASONABLY AVAILABLE CONTROL
TECHNOLOGY (RACT)

Source Type	RACT (% Usage)*	Energy Impact Data (Reference)
Petroleum Refining	Inspection and Maintenance (100)	A (ARB, 1978)
Petroleum Refinery Evapor		
o storage and blending	Floating roof w/2o seal (90); Vapor recovery (10)	B (EPA 1977a); C (assumed per bulk gas plant)
Gasoline Distribution		
o bulk plant storage tank	Vapor balance (99)	C (EPA, 1977b)
o bulk plant truck loading		
* large plants	Vapor recovery (100)	D (EPA, 1977c)
* small plants	Vapor balance (50)	C (EPA, 1977b)
o trucking	Inspection and Maintenance (100)	A (assumed per refinery)
o filling station spillage	Inspection and Maintenance (100)	A (assumed per refinery)
o filling station storage		
* large tanks (>2 kgal)	Vapor balance (100)	C (assumed per bulk gas plant)
o filling vehicle tanks	Vapor balance (90)	C (ARB, 1975)
Other Organic Compounds Evap.		
o solvent storage tanks		
* large w/hi v.p.(>40kgal)	Floating roof, 2o seal (90); vapor recovery (10);	B (assumed per refinery); C (assumed per bulk gas plant);
* medium (2k-40k gal)	Submerged fill (100)	B (assumed per bulk gas plant);
o other organic storage tanks		
* large w/hi v.p.(>40kgal)	Floating roof, 2o seal (90); Vapor recovery (10)	B (assumed per refinery); D (assumed per bulk gas plant);
* medium (2k-40k gal)	Submerged fill (100)	B (assumed per bulk gas plant);
o structure coating	Low solvent (90)	E (ARB, 1977)
o industrial coating		
* can and coil	Low solvent & afterburners (100)	F (ARB, 1978a) + G (EPA, 1977d)
* fabric and paper	Carbon adsorption (40); After-burner (40); Water scrubber (10)	A (ARB, 1978b); G (assumed per can coating); H (ARB, 1978c)
o paint/solvent mfg	Condensation and recovery (100); Condensation and recovery with afterburner (50)	I; J
o cutback asphalt	Slow cure + water emulsion + hot mix (90)	K (EPA, 1977e)
o degreasing (all solvents)	Inspection and maintenance (100); Refrigerated chillers (25)	A (assumed per refinery); L (EPA, 1977f; ARB 1978d)
o dry cleaning (all solvents)	Inspection and maintenance + carbon adsorption (100)	A (assumed per refinery) + A (assumed per fabric and paper)

* Definition of ACT and percent usage obtained from BAAQMD (Phillips, 1979).

A. This ACT produces energy savings equal to the energy content of the recovered material.

B. This ACT produces no significant adverse energy impacts.

C. Vapor recovery produces a minimal net energy impact.

D. Vapor balance does not consume energy.

E. Energy impacts not evaluated due to lack of data; use of low-solvent coatings should produce energy savings equal to the energy content of the "unused" solvent.

F. A typical coating facility can save as much as thirty million cubic feet of gas per year by switching to low-solvent coatings.

G. Afterburners (non-catalytic incineration) with primary and secondary heat recovery produce net fuel savings ranging from 0.34 million Btu/hr at process gas flow rate of 5000 SCFM to 0.66 million Btu/hr at 15000 SCFM.

H. Net overall energy savings due to solvent recovery.

I. No data on condensation available; energy is required to operate condensers, but energy is saved by recovering the condensed vapor.

J. Addition of afterburners, if heat recovery is used, should not significantly affect energy consumption.

K. Any type of cutback asphalt (Fast, medium, or slow cure) consumes approximately 50,200 Btu/gal for manufacture, process, and laying; water emulsion consumes approximately 2830 Btu/gal for manufacturing, processing, and laying.

L. Refrigerated chillers consume approximately 0.5 kw-hr per 1.5 kg of solvent saved; the energy content of the solvent is much greater than the energy expended to conserve the solvent.

TABLE 7

Summary of Studies on Fuel Economy Benefit Due to Inspection and Maintenance

	Study	Sample[a]	Screening Test Used to Determine Failure	Repaired Vehicles Average Fuel Economy Benefit[b]
1.	EPA's Portland Study	93 1972-74 Models 11C 1975-77 Models	Oregon State Inspection Test (30% failure rate) (Idle Test + Brief Phy. Insp.)	1972-74: 0.6%[c] 1975-77: -0.7%[c]
2.	I/M-Oriented Analysis of EPA's RM 76 Program	97 1975-76 Models	Idle Test (30% failure rate)	3.9%[c]
3.	I/M-Oriented Analysis of EPA's RM77 Program	11 Very Low Mileage 1977 Models	Idle Test (25% failure rate)	4.0%[c]
4.	EPA's Analysis of Data from CARB's LDVSP-11	31 1975-77 Models	Idle Test (20% failure rate)	1.8%[c]
5.	EPA's Analysis of Data on 3-Way Catalyst Equipped Vehicles	7 Feedback Carburetion Vehicles	Visual Inspection of Oxygen Sensor or Spark Timing	9%-30%[c]
6.	EPA's Analysis of Data from CARB's Riverside Program	349 1955-74 Models	Idle Test (35% failure rate)	Pre-71: 3.1%[d] 1971-74: 2.0%[d]
7.	NHTSA 322-Car Study	322 1968-73 Models	Loaded or Idle Test	4.7%[e]
8.	NHTSA 57-Car Study	57 1969-72 Models	Loaded Test	3.5%[c]
9.	Champion Spark Plug Co. Studies	310 pre-68 to 1975 Models (mostly pre-75)	Extensive Diagnostic Inspection	11.4%[f]
10.	CARB Degradation Study	59 1968-74 Models	Idle Test (40% failure rate)	3.1%[g]
11.	Private Vehicle Fleet I/M	U.S. Postal Service, Baltimore Cty. Trans., & A.T. & T. fleets	Emission Tests	4%- 10%[h]
12.	EPA's I/M Information Document (EPA-400/2-78-001)	Mathematical Model	--	4%- 10%[i]
13.	J. Panzer's Model of Fuel Economy Benefit	Mathematical Model	Idle Test (varying failure rate)	8%- 14%

[a] All vehicles described here have undergone maintenance due to failure of screening test.
[b] As measured immediately after maintenance; except as noted.
[c] EPA city/highway combined fuel economy (55% city driving, 45% highway driving.)
[d] As measured over the 75 FTP (EPA's city driving cycle.)
[e] As reported by vehicle owners.
[f] After full tune-up to manufacturer's specification, plus mandatory replacement of spark plugs. Fuel economy is measured over a transient.cycle representative of the Toledo metropolitan area's driving patterns.
[g] As measured over the 72 FTP (bag 1 and 2 of the 75 FTP). This assumes that all vehicle stall-ups are from a cold engine condition.
[h] No standard test procedure was used to determine fuel economy benefit; not necessarily as measured immediately after maintenance.
[i] Estimated annual fuel economy benefit.

Source: EPA, 1979

Data Needed But Not Readily Available

RACT Energy Impacts. In order to quantify the energy impacts of the RACT Policy Action the following data are needed:

- o quantity of petroleum products recovered through use of inspection/maintenance in Bay Area refineries;
- o quantity of petroleum products recovered through use of inspection/maintenance, floating roof tanks with secondary seals, vapor recovery, and vaper balance systems in the Bay Area;
- o volume of gasoline saved at bulk gasoline plants in the Bay Area through the use of inspection/maintenance;
- o energy impacts of low-solvent architectural coatings;
- o total volume of solvent saved per year in the Bay Area through the use of low-solvent coatings in the can and coil industry;
- o total process gas flow rate per year in the Bay Area for the can and coil and fabric and paper coating industries;
- o total volume of solvent collected by carbon adsorption per year in the fabric and paper coating industry in the Bay Area;
- o total volume of solvent recovered by water scrubbers per year in the fabric and paper coating industry in the Bay Area;
- o energy demands of condensation and recovery control technology;
- o total gallons of cutback asphalt manufactured, processed and laid in the Bay Area per year; total gallons of water emulsion asphalt manufactured, processed, and laid in the Bay Area per year;
- o energy demands of manufacturing, processing, and laying hot-mix asphalt;
- o total mass of solvent recovered by refrigerated chillers per year at degreasing plants in the Bay Area; energy content of the recovered solvent (Btu/mass solvent);
- o total volume of solvent recovered per year by inspection/maintenance and carbon adsorption at dry cleaning plants in the Bay Area;
- o definitions and percent usage of ACT's for all stationary HC sources not listed in Table 6.

NSR Energy Impacts. The following data are needed to estimate the energy impacts of using New Source Review (NSR) on new industrial facilities in the Bay Area:

- o Number of new sources that came into the Bay Area (applied for permits to construct and operate);
- o Description of control equipment that the NSR rule required the sources to use;
- o Detailed description of any offsets used;
- o Energy demands of the control equipment (from the EPA control technology guidelines (CTG's) or ARB staff reports on model rules);
- o Energy impacts of offset arrangements determined from:
  - Number of older, less energy-efficient sources shut down due to offset arrangements;
  - Description of control equipment added to existing sources and the energy demands of that equipment;
- o The extent to which NSR prevents existing sources from becoming more energy-efficient through industrial process changes (this is difficult to determine and could assume neglible, e.g.,. Shell Martinez refinery modernization). Phase II will be concerned with either obtaining these data or else making assumptions in order to estimate these data.

Data Not Available

Estimating the energy impacts of some 1979 BAAQP policy actions requires data that are not readily available or can't be accurately estimated. These policy actions and corresponding data needs are listed in Table 8.

METHODOLOGY

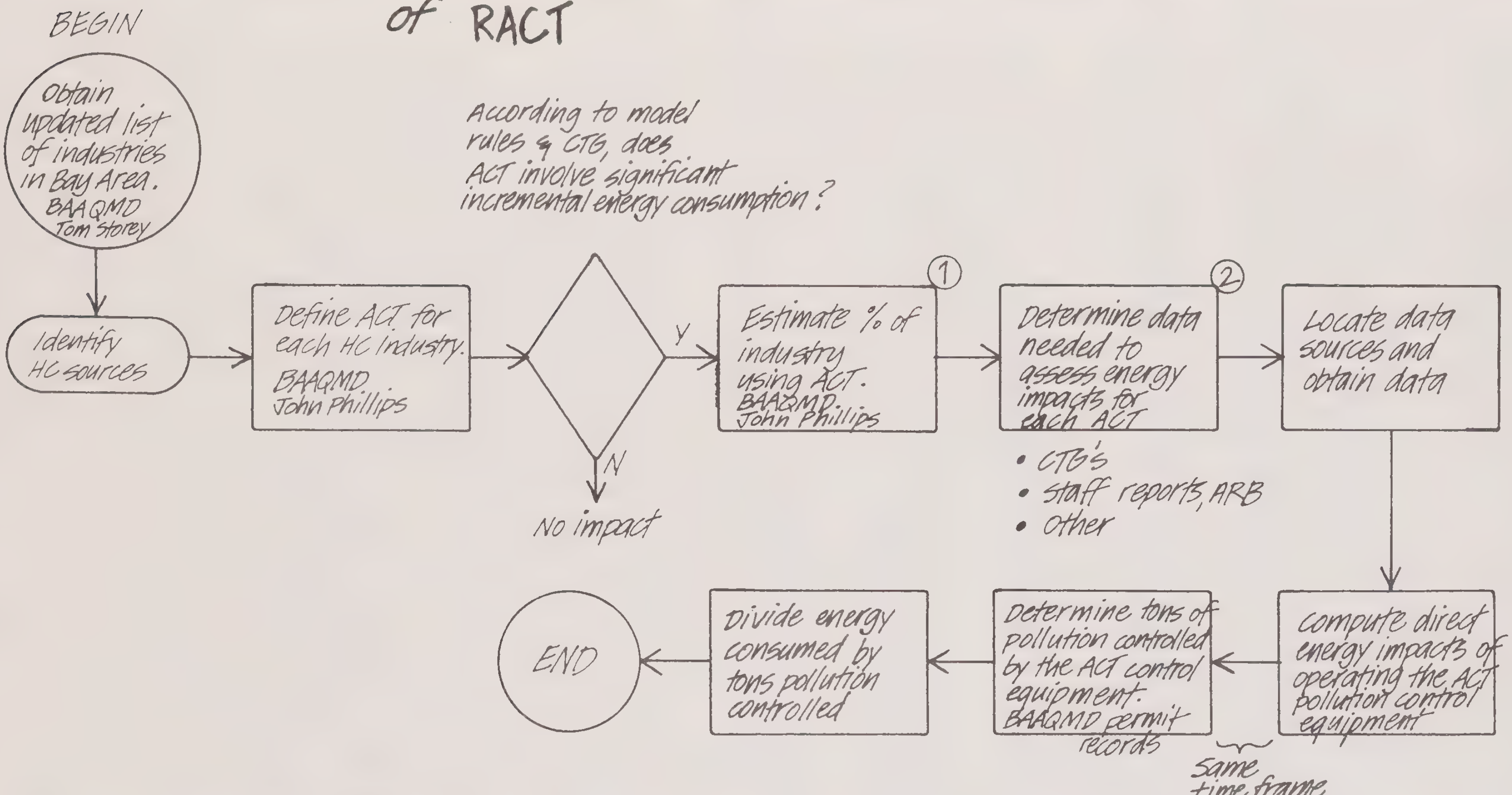
Reasonably Available Control Technology

Figure 7 is a flowchart representing the methodology developed to assess the energy impacts of using ACT on existing stationary HC sources. One of the critical steps in the methodology is determing the data required to calculate the energy demands or benefits. The available energy impact data found in the EPA Control Technology Guidelines (CTG's) or the ARB Staff Reports on Model Rules are expressed in a variety of forms, ranging from energy consumed per unit product manufactured to energy consumed per X number of facilities (See Table 6). Determining the direct incremental energy impacts of the RACT Policy Action will entail a considerable data collection and manipulation effort or will require the use of assumptions to approximate the needed data.

TABLE 8
SUMMARY OF UNAVAILABLE DATA NEEDED

Policy Action	Data Needed
Parking Strategies	o Fuel saved due to use of Carpools and Vanpools * The number of carpools and vanpools that were formed due to availability of preferential parking * The change in transit mode VMT resulting from the vanpool and carpool formation * Energy demands of pre-carpool and pre-vanpool transit modes * Energy demands of carpools and vanpools formed due to availability of preferential parking
	o Fuel saved by Vanpool and Carpool not Looking for Parking Space: * Gas mileage of vehicles used in vanpools and carpools * Driving mileage "saved" by not looking for parking space
Ride-Sharing	o The change in transit mode for the passengers of the services
	o The energy demands of pre-ridesharing service transit modes (vehicle gas mileage and miles travelled)
	o Energy demands of ridesharing service vehicles (vehicle gas mileage and miles travelled)
Bicycle Systems	o The change in transit made for users of the bicycle systems
	o The energy demands of the pre-bicycle system transit mode (bicycles are powered by renewable energy source; the energy demands of the bicycle transit mode therefore need not be addressed)

Figure 7. *Methodology for estimating energy impacts of RACT*



1 – For a given type of industry, estimate the percent using the estimated ACT, e.g. metal coating has low solvent ACT: all metal coating plants in area, what % are using low solvent?

2 – Based on the literature, what data are needed to calculate energy impacts; ie, how are the energy demands of the ACT's expressed? (energy spent per unit product, energy saved per facility, etc.)

I/M and Other Policy Actions

Methodologies for assessing the energy impacts of the other policy actions were not developed because either they were not needed to discuss energy impacts (as was the case with the inspection/maintenance policy action), or because no impact data were available with which to test the methodologies.

Conclusions

Phase I work in assessing the direct incremental energy impacts of the 1979 Bay Area Air Quality Plan (BAAQP) consisted of the following tasks:

- o literature search to identify similar or related studies and to locate energy data;
- o air quality plan policy screening and analysis; translation of the broadly-scoped, general wording of the policies into discrete technical statements;
- o based on information in literature, determination of data needed to assess the energy impacts of the policies;
- o classification of policies: those for which data were obtained to estimate energy impacts, those for which data were available but were not located, those for which no data exist, and those that have no energy impacts;
- o for the policies of the first class, development of a methodology to assess energy impacts;
- o collection of available data for estimating energy impacts and identification of additional data needs.

Phase II will consist of applying the methodology to the data collected to estimate the energy impacts of all the policy actions contained in the BAAQP. Quantifying the energy impacts of all the policy actions contained in the BAAQP, in terms of developing a ratio of energy units spent or gained per unit of pollution controlled, will not be possible, primarily because of lack of availability of the required data. Only two policy actions - use of available control technology on existing stationary hydrocarbon sources and implementation of a statewide vehicle inspection and maintenance program - were identified as being amenable to energy impact analysis. In the long run, only one other policy action - use of New Source Review on new industrial facilities-could be analyzed for its energy impact, and only after a considerable data collection effort. Analyzing the energy impact of the BAAQP will most likely be done on a qualitative or semi-quantitative level.

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PRELIMINARY ENERGY IMPACT ASSESSMENT OF WATER QUALITY MANAGEMENT PROGRAMS

The preliminary energy impact assessment for water quality management programs (as well as the solid waste programs described in the next section) could not be addressed at the same level of detail as the air quality programs. This was due to the fact that the water quality (and solid waste) programs as adopted in the ABAG Environmental Management Plan lack specificity at this time. As a result, the preliminary assessment for water quality management programs was focused in three tasks:

- o Development of methodologies to be used in assessing energy impacts in Phase II of this study;
- o Collection of energy requirement information for local wastewater systems, including existing and future facilities; and
- o Collection of energy requirement information for various surface runoff management practices.

Progress on these three tasks are reported below. When completed, the results of these tasks will form the basis for conducting energy impact assessments of water quality management programs, and integrating energy conservation and water quality management programs during Phase II.

Development of a Methodology for Energy Impact Assessment of Water Quality Management Programs

Different methodologies for energy impact assessment are developed for the two major elements of the Bay Area's water quality management program: municipal wastewater facilities and surface runoff management.

Municipal Facilities Element. The major recommendation of the municipal facilities element of the Bay Area's water quality management program is to provide adequate municipal wastewater facilities to dispose of wastewater from homes and business without posing a threat to public health, welfare or the environment. It was also recommended that facilities be sized to serve the level of growth consistent with regional goals. The needed wastewater treatment facilities over the next 20 years are summarized in ABAG's 20-Year Municipal Facilities Needs List. There are more than 200 projects on ABAG's recently updated list. These include upgrading existing plants to secondary treatment levels, plant expansions, wet weather reclamation facilities, wastewater and sludge management projects, and others. Since the initial planning step for most projects on the list will not start until some time in the future, the complete design data necessary for detailed energy assessment are not currently available. In addition, the resources available for this study do not allow a detailed energy balance analysis for the projects having complete design information. A methodology for energy impact assessment at the regional level, developed by taking into account the above-mentioned factors, are described below.

The methodology to be used for regional energy impact assessment involves the following steps:

Step 1: Determine the distribution of levels and types of treatment for baseyear, 1985 and 1990--The Federal Water Pollution Control Act Amendments of 1972 and 1977 establish secondary treatment as the minimum level of performance for municipal treatment facilities. This law also requires that all publicly-owned treatment works provide the best practicable waste treatment technology (BPT) not later than July 1, 1983. Specific standards for BPT have not been issued by the U.S. Environmental Protection Agency. As mentioned earlier, the 20-year project list includes construction of new plants, upgrading treatment level of existing plants, plant expansion, and others. Work is currently being carried out to determine the levels of wastewater treatment within the 50 sewage service districts in the Bay Area. The result of this step will be presented in a format as shown in Table 9.

The type of treatment for future facilities is difficult to estimate. The reason is that there are a number of treatment processes which can be used to achieve a specific treatment level. For the purpose of this study, several most representative processes will be selected for each level of treatment. The distribution of types of treatment will then be estimated for the future facilities (see Table 10).

Step 2: Determine the direct and indirect energy requirements for each type of treatment as a function of plant capacity.

Step 3: Based on the results of Steps 1 and 2, calculate total energy required for planned and proposed wastewater treatment facilities.

Surface Runoff Element. ABAG is currently working with Bay Area counties to develop a specific surface runoff management plan to be adopted by each county. A draft plan is expected to be completed by June, 1980. The potential measures currently under consideration are mostly not energy intensive, e.g., improvement of street sweeping, drainage systems maintenance, control of contaminants from domestic animals, etc. A simplified approach will be used to estimate their potential energy impacts. Three steps are involved:

Step 1: Collection of energy requirements of various surface runoff management practices.

Table 9

Sample Format for Estimating the Distribution of Levels of Wastewater Treatment in the Bay Area

Treat. level / Year	Primary		Secondary		Advanced	
	No. of units	Total MPG	No. of units	Total MPG	No. of units	Total MPG
1980						
1985						
1990						

Table 10

Sample Format for Estimating the Distribution of Types of Treatment for Future Facilities

Treatment level	Representative process	Distribution (%)
secondary	o activated sludge with anaerobic digestion	30
	o oxidation ponds	20
	o trickling filter with coarse filtration	20
	o ---	
	o ---	
advanced	o primary sedimentation with alum addition; biological nitrification	30
	o primary sedimentation; high rate activated sludge with ferric choloride addition; biological nitrification	20
	o ---	
	o ---	
	o ---	

Step 2: Estimation of level of implementation for selected management measures.

Step 3: Calculation of the associated total energy uses.

Step 1, Collection of Related Energy Data, has been partially completed and will be discussed in the next section. Work under Steps 2 and 3 will be carried out during Phase II when the specific surface runoff management plan is completed.

Collection of Energy Requirement Information for Wastewater Treatment Systems

A literature review has been conducted to collect energy use data for various types of municipal wastewater treatment systems. Most of the literature reviewed address energy consumption of certain unit processes or specific types of equipment. Only a few reports discuss total energy use for the entire treatment system (Robert, 1977, Smith, 1978, Culp 1970). Roberts' report is one of the most comprehensive reports on energy analysis of municipal wastewater facilities. The results of this preliminary literature review are summarized below.

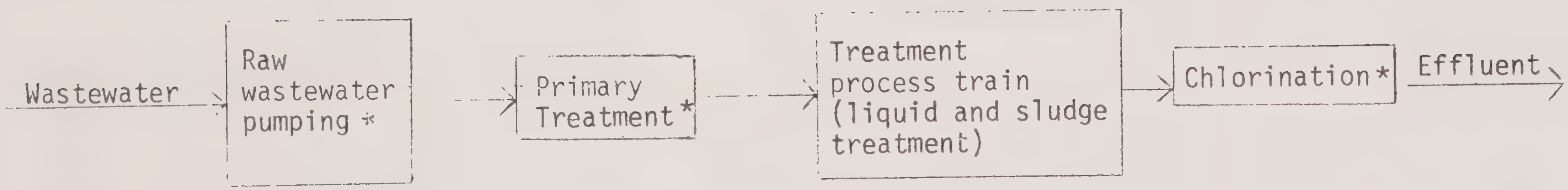
Figure 8 shows a simplified schematic diagram for a typical treatment process. Since preliminary treatment, raw wastewater pumping, and chlorination are required for almost all treatment systems, the energy uses associated with these three unit processes are reported separately (see Table 11). The energy use estimated for major treatment processes (liquid and sludge treatment processes) are presented in Table 12. The data collected will be used in total energy use analyses to be conducted in Phase II.

It should be pointed out that the processes shown in Table 12 are just some of the representative treatment systems. There are many more treatment process alternatives which may be used for future facilities. As can be seen, total energy consumption generally increases as the treatment level increases. The energy use data shown in Tables 11 and 12 are for typical designs using the cited processes. There are many design improvements and/or modifications which can be incorporated into a treatment system to conserve energy. For example, the anaerobic digestion process to treat sludge with reuse of digestion gas (see Table 12) can recover a significant amount of energy. Central Contra Costa Sanitary District is currently studying a system which will use processed sludge and refuse-derived fuel to generate steam and electricity.

In addition to the energy requirements reported in the literature, energy consumption data is also being obtained directly from the more than 60 treatment plants in the Bay Area. However, the energy data obtained from these sources will be the direct electricity and fuel consumed, while the data shown in Tables 11 and 12 include construction, power, fuel and chemicals-related energy consumption.

Figure 8

Simplified Schematic Diagram of a Typical
Wastewater Treatment Process



* Required by most treatment systems

Table 11

Total Energy Requirements for Raw Wastewater Pumping, Primary Treatment, and Chlorination* ‡

Process	Total Energy requirements (KWH/year)				
	Treatment capacity (MGD)				
	1	5	10	20	100
Raw wastewater pumping	100,000 (341)**	300,000 (1,024)	800,000 (2,730)	1,050,000 (3,584)	7,000,000 (23,891)
Primary Treatment	11,500 (39)	30,000 (102)	70,000 (239)	100,000 (341)	200,000 (682)
Chlorination	90,000 (307)	250,000 (653)	750,000 (2,560)	1,100,000 (3,754)	8,000,000 (27,304)

* Total energy requirements associated with Construction and power, Fuel and Chemicals use during the normal operations

‡ Source: Roberts, 1977

** Numbers in parentheses are in the unit of 1 million BTUs/year

Note: MGD = million gallons per day
1 KWH = 3413 BTUs

Table 12

Reported Total Energy Requirements for Selected Wastewater Treatment Processes*

Treatment Process Train	Total Energy Requirements (x1000 KWH/yr)				
	Capacity (MGD)				
	1	5	10	20	100
Secondary Treatment Processes (Liquid Treatment)					
1. Primary sedimentation and trickling filters	344 (1.17)**	772 (2.63)	1,319 (4.50)	2,264 (7.73)	10,342 (35.30)
2. Primary sedimentation and activated sludge	520 (1.77)	1,350 (4.61)	2,395 (8.17)	4,436 (15.02)	20,521 (70.04)
Secondary Treatment Processes‡ (Sludge Treatment)					
1. Vacuum filtration, incineration, and landfill disposal of ash	411 (1.40)	1,114 (3.80)	1,978 (6.75)	3,421 (11.68)	13,934 (47.56)
2. Vacuum filtration and landfill disposal of dewatered sludge	109 (0.37)	323 (1.10)	593 (2.02)	1,111 (3.79)	5,273 (18.00)
3. Heat treatment, vacuum filtration, incineration, and landfill disposal of ash	342 (1.17)	907 (3.09)	1,658 (5.66)	3,086 (10.53)	13,100 (44.71)
4. Heat treatment, vacuum filtration, and landfill disposal of dewatered sludge	207 (0.71)	713 (2.43)	1,350 (4.61)	2,621 (8.94)	12,636 (43.13)
5. Anaerobic digestion, vacuum filtration, landfill disposal, and digester gas reuse	179 (0.61)	70 (0.24)	-313 (-1.07)	-928 (-3.17)	-5,625 (-19.20)

Total Energy Requirements (x1000 KWH/yr)

Treatment Process Train	Capacity (MGD)				
	1	5	10	20	100
6. Anaerobic digestion, sludge drying beds, landfill disposal, and digester gas reuse	110 (0.37)	-55 (-0.19)	-515 (-1.76)	-1,270 (-4.33)	-7,030 (-24.00)
<u>Advanced Treatment Processes</u> (Combined liquid and sludge treatment) 1. Primary sedimentation, high rate activated sludge, biological nitrification, biological denitrification, anaerobic digestion, vacuum filtration, landfill disposal, and digester gas reuse	1,290 (4.40)	4,187 (14.29)	7,435 (25.37)	13,916 (47.50)	64,985 (221.80)
2. Primary sedimentation, activated sludge, two-stage tertiary lime treatment, ammonia stripping, vacuum filtration, and landfill disposal	2,225 (7.59)	9,032 (30.83)	17,514 (59.78)	34,397 (117.40)	168,980 (576.73)
3. Primary sedimentation, activated sludge, two-stage tertiary lime treatment, ammonia stripping, gravity filtration, activity carbon adsorption, vacuum filtration, and landfill disposal	2,737 (9.34)	10,715 (36.57)	20,622 (70.38)	40,298 (137.54)	196,240 (669.77)

* Total energy requirements include energy use associated with construction, and power, fuel and chemical use during normal operations

** Numbers in parenthesis are in the unit of billion BTUs/year

ǂ Any of these 6 sludge treatment processes can be combined with the liquid treatment processes listed above.

Note: Source: Roberts, 1977

1 KWH = 3413 BTUs

Collection of Energy Requirement Information for Surface Runoff Management Practices

As mentioned earlier, ABAG is currently preparing a specific surface runoff management program to be adopted by Bay Area counties. The management measures that may potentially be adopted in the program are shown in Table 13. As can be seen, most of the measures under consideration are not energy intensive. To date, no direct energy use information associated with the measures shown has been found in the numerous reports reviewed. However, costs of various surface runoff controls have been reported in several reports (Pitt, 1979, Thronson, 1973, Ateshian, 1972). In Phase II of this study, an appropriate methodology will be developed to estimate energy consumption rates based on the estimated costs.

Table 13

Surface Runoff Controls under Consideration

EMP-adopted policy	Recommended Actions
Require BMPs in rural areas	1) Rural grading ordinance applies where there is not an approved conservation plan 2) Develop conservation plans for critical landholdings
Implement or improve public works control measures for water quality protection	Public works control measures should incorporate one or more of the following: 1) improve street sweeping 2) repair streets 3) control use of certain chemicals 4) control use of lots 5) control contaminants from domestic animals 6) litter control/leaf removal 7) storm drain system maintenance
Conduct public education program on erosion and sediment control	1) Flyers attached to permits, brochures w/ property deeds 2) Displays in public buildings, slide shows, media, etc. 3) Workshops for developers and contractors.
Require erosion control plan with building permits	1) Adopt ordinance to require erosion control plan with building permits. 2) Erosion control plans should incorporate one or more of the following: a. minimization of extent and duration of construction disturbances b. retain natural vegetation where possible c. temporarily vegetate or mulch critical areas exposed during construction d. permanently stabilize land surface as soon as practical e. fit development plans to local soils and topography to maximum extent possible
Require BMPs to mitigate construction impacts	1) Adopt or improve ordinance 2) Adopt BMP Handbook as official policy 3) Require BMPs as permit conditions
Increase enforcement of erosion control ordinances	1) Hire additional construction site inspector(s) 2) Train inspectors in BMPs for erosion and sediment control 3) Strengthen ordinance to require one or both of: a. performance bond or letter of credit b. penalties for non-performance

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PRELIMINARY ENERGY IMPACT ASSESSMENT OF SOLID WASTE MANAGEMENT PROGRAMS

The tasks performed in Phase I as the foundation for the Phase II energy impact assessment were as follows:

- o Identifying current solid waste management practices in the Bay Area;
- o Preparing an inventory of planned and proposed solid waste energy recovery projects in the Bay Area; and
- o Identifying energy conservation and/or supply issues related to future Bay Area solid waste management trends.

The results of these tasks will form the basis for conducting subsequent energy impact assessments of solid waste management programs and integrating energy conservation and solid waste management programs.

Identification of Current Solid Waste Management Practices

As an initial task of this study, current solid waste management practices in the Bay Area have been identified. This will provide the basis for estimating baseline energy use of solid waste management programs.

As shown in Table 14, the estimated quantities of total municipal waste generated in the Bay Area was approximately 6.1 million tons in 1975, and is expected to reach 6.9 million tons in 1980 (SSWMB, 1977). In general, cities, counties and special districts are responsible for collection, processing, transportation and disposal of generated wastes within their jurisdictions.

At present, the majority of the generated wastes is disposed of at landfill sites. Municipal wastes are usually taken by collection trucks directly to landfill sites for disposal. However, in some cases, because of the long distance between collection points and disposal sites, transfer facilities are needed to reduce transportation costs. At a transfer station, collected wastes are transferred to much larger long-haul trucks before wastes are transported to a disposal site. In 1975, there were five such transfer stations in the Bay Area. There are currently 52 Class 2 landfill sites and 3 Class 1 landfill sites in the Bay Area. The overall solid waste management system for the Bay Area is illustrated in Figure 9.

Recently, ABAG completed a study entitled "Solid Waste Facilities Study for the San Francisco Bay Area," (ABAG, 1979). In this study, a computerized file data base was developed for 52 Class 2 landfill facilities in the Bay Area. For each facility, physical descriptions, operating characteristics, average hauling distance, size of service area, and other data are included. During Phase II of this study, pertinent data contained in the file data base will be retrieved for estimating total energy consumption associated with solid waste collection, processing and transportation in the Bay Area.

TABLE 14

Summary of Estimated Solid Waste Quantities Generated in Each County in 1975, 1980 and 1990 (in 1000 tons/year)

County	Year	Municipal Wastes[a]								Hazardous Wastes[b]	Wastewater Solids/Sewage Sludge[c]	Agricultural Wastes[a]	Total[d]
		Residential	Commercial	Industrial (Non-Manufacturing)[e]	Uncollected	Construction, Demolition	Litter/Street Sweepings	Food Processing	Subtotal				
Alameda	1975	490	377	216	f	g	g	78	1161	109	88	125	1423
	1980	530	423	238	f	g	g	g	1269	140	166	g	1703
	1990	660	497	289	f	g	g	g	1524	226	175	g	2050
Contra Costa	1975	203	146	78	39	104	2.6	i	610	413	38	222	1283
	1980	230	160	81	42	113	2.8	g	667	529	191	217	1604
	1990	286	187	95	48	127	3.6	g	785	857	242	208	2092
Marin	1975	98	98	9	f	17	5.5	h	228	1	12	601	842
	1980	117	117	10	f	19	7.0	h	270	1	13	601	885
	1990	158	158	11	f	24	9.0	h	360	2	14	601	977
Napa	1975	25	25	f	f	4	h	8	62	0	2	2	66
	1980	26	27	f	f	6	h	8	65	0	28	2	96
	1990	29	29	f	f	7	h	8	73	0	34	2	109
San Francisco	1975	270	208	f	f	650	27	g	1155	17	53	2	1227
	1980	290	227	f	f	650	32	g	1199	22	124	2	1347
	1990	323	265	f	f	650	33	g	1271	36	132	2	1441
San Mateo	1975	270	279	95	f	136	43	5	828	35	56	44	963
	1980	297	308	100	f	150	46	5	906	44	68	44	1062
	1990	360	372	110	f	182	50	5	1079	72	73	44	1268
Santa Clara	1975	562	218	232	114	312	30	158	1626	76	168	198	2068
	1980	650	251	294	125	343	g	g	1851	97	265	163	2376
	1990	856	327	366	149	405	g	g	2291	157	292	150	2850
Solano	1975	87	72	15	f	13	21	16	224	158	8	775	1165
	1980	103	81	19	f	16	25	198	442	203	74	814	1533
	1990	161	141	21	f	27	41	223	614	328	93	862	1898
Sonoma	1975	90	91	f	f	20	6.8	h	204	11	24	2231	2474
	1980	107	107	f	f	23	8	h	245	14	55	g	2545
	1990	120	119	f	f	27	9	h	275	22	55	g	2583
TOTAL[d]	1975	2100	1500	650	150	1300	150	250	6100	820	450	4200	11500
	1980	2400	1700	740	170	1300	180	420	6900	1050	983	4200	13000
	1990	3000	2100	890	200	1400	250	640	8500	1700	1109	4200	15500

[a]Quantities estimated by the State Solid Waste Management Board based on County Solid Waste Management Plans, in the Bay Area Solid Waste Management Project - Phase I Report, February, 1977.

[b]Rough quantities estimated by ABAG. It was estimated that about half of these wastes generated would be disposed of at hazardous waste disposal sites (Class I sites). Tonnages shown are mostly in liquid form; residues requiring land burial after evaporation are a very small proportion of the liquid waste.

[c]Quantities estimated by the San Francisco Bay Region Wastewater Solids Study (assuming 80% moisture content).

[d]Totals have been estimated and rounded.

[e]Non-manufacturing industrial wastes produced from activities not directly associated with production, such as office and shipping materials.

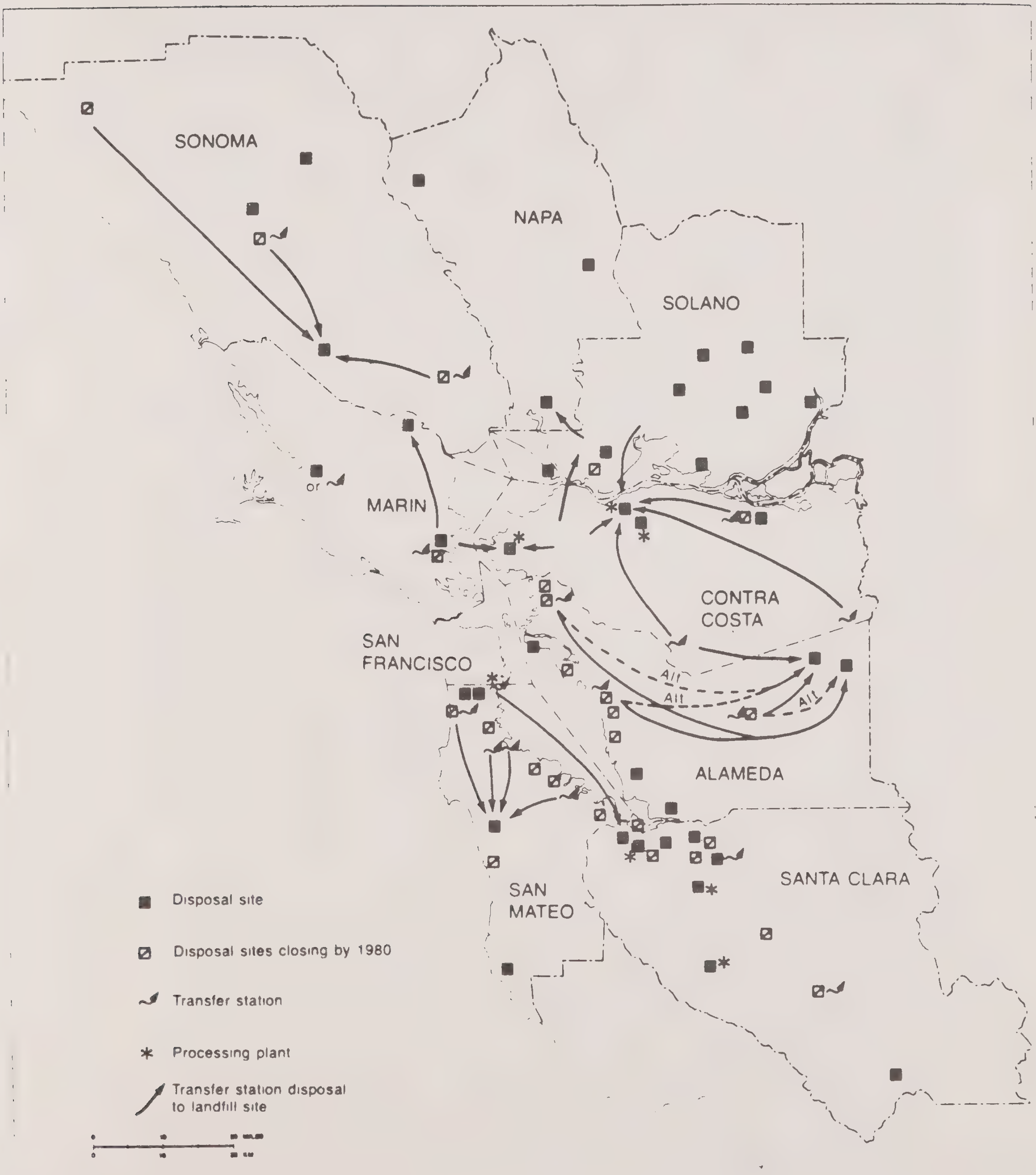
[f]Quantities included in Residential, Commercial or Non-Manufacturing Industrial Categories.

[g]Quantities not reported or estimated.

[h]Quantities negligible.

[i]Two million gallons per day.

Figure 9 **Solid Waste Management System for the Bay Area (1975-1980)**



In addition to landfill disposal, there are a number of small-scale recycling centers in various communities. These centers recover materials such as ferrous metals, aluminum, tin, glass, cardboard, whitepaper, and/or newsprint. A preliminary inventory of current resource recycling projects in the Bay Area is given in Table 15. The total amount of materials currently being recovered at those recycling centers is approximately 0.13 million tons per year, or approximately 2 to 3 percent of the total municipal waste stream. Energy intensiveness of various materials found in municipal waste streams are shown in Table 16 (Shuster, 1970). As can be seen, recycling these materials will save a significant amount of energy. A literature review is currently being conducted (Reid, 1978, NCFRR, 1974, Drobny, 1971) and a methodology for quantifying energy savings from resource recycling will be developed.

Energy Conservation and Supply Issues Related to Future Bay Area Solid Waste Management Trends

The energy-related issues that will influence future Bay Area solid waste management trends are discussed below:

- Resource Depleting Effects of Current Management Practices--As noted previously, disposal of solid waste at landfills is the major method currently being used by Bay Area jurisdictions. This conventional disposal method discards a substantial amount of material and potential energy which could be recovered. As shown in Table 16, recycling materials and/or reduction in waste generation could realize significant energy savings. Additionally, a great portion of organic municipal wastes can be converted into a fuel or electricity. Table 17 shows the range of energy resources that may be available from the municipal wastes generated in the Bay Area. Continuation of the present practice of landfilling means continuing depletion of energy and material resources. There is an increasing need for: (1) reduction in waste generation, (2) reduction of waste going to landfills, and (3) developing new and improved methods of processing and recovering materials and energy from solid wastes. The need in these three areas has been emphasized in the regional solid waste management plan adopted by the ABAG General Assembly in June 1978.

- Dwindling Energy Supply and Increasing Energy Cost--Dwindling domestic supplies of natural gas and oils coupled with the rapidly increasing costs of imported oils have prompted utility companies to seek alternatives or supplemental fuels. Pacific Gas and Electric Company (PG&E) has been using methane recovered from sanitary landfills at Mountain View (EPA, 1978). PG&E also had commissioned Stanford Research Institute to conduct a preliminary assessment of refuse from the Bay Area as a fuel for power generation. Current energy supply and cost situations have made waste-to-energy systems more favorable than before. Further increases in cost of petroleum-based fuels will certainly make energy produced from solid waste more economically competitive.

Table 15. Inventory of Current Resource Recovery (Recycling) Projects in the Bay Area

County	Current Resource Recycling Projects and Activities
Alameda	o Community recycling programs in Berkeley, Hayward, Castro Valley, San Leandro, Union City, Livermore, Dublin, and Oakland have recovered more than 22,000 tons of reusable materials such as ferrous metals, aluminum, tin, glass, cardboard and newsprint each year.
Contra Costa	o Community recycling programs in Richmond, Pittsburg, El Cerrito and Concord and recovery programs at landfills have recovered more than 8,000 tons of reusable materials each year.
Marin	o Community recycling programs in San Rafael, Mill Valley, Corte Madera, Belvedere, Tiburon, and San Anselmo and recovery program of scavenger companies have recovered more than 6,800 tons of reusable materials each year.
Napa	o Two disposal companies and two distributing companies have recovered about 760 tons of reusable materials each year.
San Francisco	o The two scavenger companies have recovered about 36,000 tons of reusable materials each year while community and school recycling programs have recovered about 1,000 tons each year.
San Mateo	o More than 15,000 tons of reusable materials is recovered each year by scavenger companies and community programs in Burlingame, San Carlos, Woodside, Foster City, Pacifica, Redwood City, San Bruno, and cities in San Mateo and South San Francisco.
Santa Clara	o Community and school recycling programs in Cupertino, Los Gatos, Mountain View, Palo Alto, Los Altos, San Jose, Saratoga and Sunnyvale have recovered more than 6,000 tons of reusable materials each year.
Solano	o Distributing companies and community recycling programs in Vallejo, Vacaville, Benicia, Fairfield, and Suisun have recovered 85,000 cases of bottles and more than 450 tons of reusable materials each year.
Sonoma	o The scavenger companies have recovered about 30,000 tons of reusable materials each year while the community recycling centers in Healdsburg, Santa Rosa and other unincorporated areas have recovered more than 1,000 tons each year.

Table 16

Energy Intensiveness of Various Materials in the Municipal Waste Stream

Material	Energy Intensiveness (KWH/metric ton)*
Aluminum	82,278
Rubber	38,272
Copper	32,810
Plastics	28,016
Textiles	23,001
Ferrous metal	14,357
Paper	7,250
Glass	5,864

*Source: Shuster, 1976

Table 17

Approximate Heats of Combustion (HHV) of Bay Area Refuse (As Received)*

Source of Refuse	Heat of Combustion (Btu per pound)	Assumed Moisture Content (percent)
Berkeley	3,680	31%
San Francisco	4,260	26
Santa Clara County	4,460	24

*Source: Ferguson, 1975

- o Establishment of Federal and State Resources Recovery and Conservation Regulations--These legislations provide financial assistance to local jurisdictions to conduct studies for large-scale waste-to-energy systems. These legislations also mandate research and development programs to advance the waste-to-energy technology. Currently, a number of Bay Area jurisdictions are carrying out studies of energy conversion systems. As more detailed studies are progressed and completed, uncertainties about system reliability and economics will be resolved, and arrangements for securing waste supplies and for financing and operating the projects will be established. The current status of waste-to-energy planning projects will be discussed in the next section.

- o Basic Problem of Sanitary Landfill--As noted previously, if filling rates continue at the current level, many of the existing landfill sites in the Bay Area will be completely filled in less than 10 years. There is a lack of suitable land in the Bay Area for additional sites. Other alternatives are either too energy intensive (e.g., long hauling to distant sites) or extremely costly. There is an increasing need for developing alternative methods for solid waste management.

The above-mentioned energy-related factors interacting with other environmental, economic, institutional, social, health and safety factors will eventually determine the course of future solid waste management in the Bay Area. Based on on-going solid-waste planning activities, it appears that there will be no significant change in existing solid waste management practices within the next two or three years. Resource recycling activities will continue to expand at a slow rate and a first large-scale waste-to-energy system may be constructed in the next 5 to 10 years. In Phase II of this study, mid- and long-term scenarios for solid waste management (e.g., level of recycling activities and amount of energy produced from recovery plants) in the Bay Area will be developed for energy impact assessment.

<u>Inventory of Planned and Proposed Solid Waste Energy Recovery Projects in the Bay Area</u>

A number of jurisdictions in the Bay Area have initiated and will continue feasibility and/or conceptual design studies for solid waste energy recovery projects. These studies are being carried out with State and Federal assistance. Table 18 is a preliminary inventory of planned or proposed energy recovery projects in the Bay Area. For each project, the sponsor(s) or responsible organization, plant capacity, processes under consideration, site location and current status are summarized.

More detailed information will be obtained when the studies are completed. In Phase II, energy balance analyses for these proposed energy recovery projects will be made and their energy impacts will be assessed.

Table 18

Inventory of Planned or Proposed Energy Recovery Projects in the Bay Area

Project	Sponsor or Responsible Organization	Capacity	Processes considered	Location	Current status
Solid-waste-fired electric generating station (Bureau of Electricity, 1978)	Bureau of Electricity, City of Alameda	1134 tons of waste/day input; generation capacity = 37 megawatts	Refuse derived fuel (RDF) processing/RDF burning plant	City of Alameda	Feasibility study completed in November 1978
Water pollution control/Resource Recovery Facilities (SFBRWSS, 1979)	Central Contra Costa Sanitary District	Refuse processing Facilities = 300~450 tons/day sludge processing = 100 tons/day	Co-combustion of processed sludge and refuse to generate electricity to power the water reclamation plant	Martinez Contra Costa County	-
U.S. Steel Corporation Resource Recovery Project (Brown & Caldwell, 1978)	Contra Costa County Public Works Dept.	800 to 12,000 tons/day solid waste input; 170 MW electricity output	Combustion of fuel gas generated from pyrolysis of RDF to generate steam and/or electricity	U.S. Steel Pittsburg	Phase II study underway
West County Agency Waste-to-Energy Project (Cooper, Clark & Assoc., 1979)	West Contra Costa County Agency	700 tons/day solid waste input	Co-combustion of processed sludge and refuse	San Pablo	Feasibility study underway
Resource Conversion Center (Environmental Science Assoc., 1979)	City and County of San Francisco and City of Brisbane	~2000 tons/day solid waste input; 34 MW electricity output	Combustion of RDF to generate electricity	City of Brisbane	Draft EIS was prepared in October, 1979
Solid Waste Resource Recovery (Bechtel, 1978)	Cities of San Jose and Santa Clara	1900 tons/day solid waste input. 266,400 MWh/yr	Combustion of RDF to generate electricity	City of San Jose or Santa Clara	-
Solid waste-to-Energy Project (Ransom, 1980)	North Santa Clara County Waste Management Joint Powers Authority	800 ~ 1300 tons/day solid waste input	Combustion of RDF or mass burning	-	Phase I study completed in December 1979
Waste-to-Energy Project (Brown, Vence & Assoc., 1980)	North Bay Counties (Marin, Napa, Sonoma, Solano, Mendocino)	3000 tons/day solid waste input	Co-generation using RDF	-	Phase I study completed
Resource Recovery Procurement Plan (GEZR, 1979)	City of Berkeley, U.S. EPA	Processing 350 tons/day of solid waste	Combination of transfering station, Resource Recovering & Energy Generation Plant	City of Berkeley	Conceptual study underway

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PUBLIC AGENCIES RESPONSIBLE FOR ENERGY REGULATION

Responsibility for planning and management of energy resources is shared among many governmental agencies at all levels of government. Managing energy supply and demand also involves significant activity in the private sector, chiefly the utility and petroleum industries. This section presents an overview of the institutional setting for energy supply/demand management. In addition, a summary of legislation and institutional activity in the specific area of solar energy is contained in Appendix E.

Federal Responsibilities in Energy Demand and Supply

Prior to passage of the Department of Energy Organization Act of 1977, responsibility for energy policy, regulation, and research, development and demonstration was fragmented among many departments and agencies of the Federal government. Reducing the fragmented decision-making and authority has been a major objective of the Carter Administration and Congress for the past several years. The new department was intended to provide a "new and sharpened scene of coherence, direction and focus to the U.S. Government's role..."

Principal units and functions transferred to the new department by the 1977 legislation were the:

- **Federal Energy Administration:** All major functions. These included oil pricing and allocation, conservation, coal use, strategic petroleum reserves, energy information, and resource development. Some minor FEA functions were transferred to the Department of Transportation.

- **Federal Power Commission:** All functions. These included natural gas regulation, interstate wholesale electric rate setting, and hydroelectric licensing.

- **Energy Research and Development Administration:** All functions. These included research and development in fossil fuels, nuclear fusion, solar and geothermal sources; uranium enrichment and production; military applications and safeguards; and conservation, environment and health research.

- **Department of Interior:** Authority over the Southeastern, Southwestern, Alaska, and Bonneville Power Administrations, and power marketing functions of the former Bureau of Reclamation (now the Bureau of Power and Water). Also included was the authority to set economic terms for leasing public land for energy development (such as the outer continental shelf), and the authority, formerly held by the Bureau of Mines, for gathering data on fuel supplies, and research and development in mining technology.

- **Navy Department:** Management of naval oil and oil shale reserves.

- **Interstate Commerce Commission:** Functions related to transportation of oil by pipeline, including pipline valuation and rate setting.

- **Department of Commerce:** Functions related to industrial energy conservation.

- **Department of Housing and Urban Development:** Authority to set energy conservation standards for new buildings.

The 1977 act also established the Federal Energy Regulatory Commission. Although located in the Department's structure, the commission is a relatively independent agency. It sets interstate oil, gas and electricity rates, although the Secretary of the Department may act instead of the commission to set oil prices in the President has declared a national emergency. The commission is also responsible for licensing hydroelectric power projects.

The creation of the Energy Department clearly reduced complexity of the Federal government's energy management activities. However, other Federal agencies, notably the Environmental Protection Agency, the Nuclear Regulatory Commission, the Department of Transportation and the Department of the Interior also have substantial roles.

The Environmental Protection Agency is responsible for administering a number of Federal laws affecting energy supply. The acts most directly affecting energy resources management include the Clean Air and Water Acts and the Resources Conservation and Recovery Act. One major effect of these laws is on the siting of major energy supply projects. Meeting clean air standards has also been a major force in altering the use of petroleum products for transportation; cleaner fuels such as lead-free or low-lead gasolines are more expensive to produce and require the consumption of more crude oil in refinery processing.

The Nuclear Regulatory Commission, created in 1974 when Congress abolished the Atomic Energy Commission, is responsible for the safety, licensing and oversight of nuclear power plants throughout the country. Thus the commission plays a significant role in determining the amount and location of nuclear-produced power.

When Congress created the Department of Energy, it transferred from the Department of the Interior to the Energy Secretary the power to set economic terms over leases for energy development on public lands. However, the Department of the Interior retained all other authority over public lands leasing, including the sole power to issue leases and to enforce their regulation. The two departments signed a memorandum of understanding in 1978 to provide coordination between the Inteior Department's energy leasing policy (administered by the Bureau of Land Management) and the national energy programs administered by the Department of Energy. The Bureau of Land Management has begun a

five-year program of oil and gas leases on the Outer Continental Shelf. A final Environmental Impact Statement under the National Environmental Policy Act is currently being prepared prior to the actual leases or sales.

The Department of Transportation's major role in energy is the administration of the fuel-economy provisions of the Energy Policy and Conservation Act of 1975, and its various grant programs for the construction of highways and acquisition of mass transit vehicles.

In terms of how responsibilities of Federal agencies are divided between influencing supply and demand, Federal responsibility is largely concentrated on influencing supply. There no longer seems to be much question that the United States must reduce its historical rates of growth in the consumption of energy. Similarly, the historical dependence of the country on energy resources of other countries must also be reduced. Federal agencies have primarily concentrated on ways to improve the supply of energy--in all forms--although significant efforts to encourage reduction in demand have also been made. Even so, efforts to reduce energy consumption (thereby reducing demand) have primarily been the responsibilities of the States and local governments, as well as the private sector. One significant Federal activity in promoting conservation has been the income credit for household conservation measures such as insultation, weatherstripping and installation of solar energy devices.

Despite the wide-reaching energy initiatives of of the past several years at the Federal level, Congress is considering additional legislation expanding the scope of national activity in energy. As Congress began its work in 1980, two conference committies were meeting to work out the final details on proposals to:

- Creation a $20 billion research prgram to develop new synthetic sources of energy, such as oil from shale and gas from coal, and creation of new, quasi-governmental agency to run the program.

- Creation of a new Federal agency--the Energy Mobilization Board--to act in place of Federal, State or local agencies that did not meet deadlines for speeding construction of priority energy projects. A major issue in the proposal is whether the proposed board would have the power to suspend or ignore the substantive requirements of Federal, State or local environmental protection laws.

State and Regional Agencies with Energy Responsibilities

Several State agencies have responsibilities for various aspects of regulating energy resources in California. Foremost among these agencies are the Energy Resources Conservation and Development Commission (often shortened to Energy Commission) and the Public Utilities Commission. Before discussing the roles and powers of these two important commissions, the energy-related duties of the other State agencies are briefly noted.

Within the Resources Agency, the Division of Oil and Gas regulates all in-state oil, gas and geothermal wells, and publishes monthly and annual reports on these wells. The California Coastal Commission regulates development within the State's coastal waters and on land within the costal zone. The commission has substantial powers over proposed development activity--including energy-related projects within the coastal zone.

The Air Resources Board establishes air quality standards for the protection of public health, and adopts regulations to ensure attainment of those standards within reasonable time periods. Major facilities, such as power plants and other energy projects, come within the jurisdiction of the ARB (and local air quality management and pollution control districts) if they produce air contaminants.

These projects are subject to the New Source Review requirements of the Federal Clean Air Act, and also are subject to the requirements to install reasonable available control technology (if they are existing sources) or, if they are subject to the NSR regulation because they are a proposed modification or new project, to install technology to produce the lowest achievable emission rate. These requirements subject major energy projects to substantial review by the ARB and local air districts.

Similar environmental protection requirements and administrative oversight occurs with respect to water quality, solid waste and hazardous wastes. These substantive areas are the responsibility of the State Water Resources Control Board (and the Regional Water Quality Control Boards), the State Solid Waste Management Board, and the Department of Health Services, respectively. In addition to setting minimum standards for solid waste handling and disposal, the State Solid Waste Management Board has sponsored a number of demonstration projects for the conversion of wastes to energy. The California Legislature in 1979 enacted legislation allowing waste-to-energy resource recovery projects to be exempted from air quality management district New Source Review regulations. The Bay Area Air Quality Management District has incorporated the provisions of this law into its recently adopted NSR rule.

The State Lands Commission conducts oil, gas, geothermal and other mineral leasing programs; the Geothermal Resources Board coordinates geothermal activities for the State.

Another State agency involved in energy is the Office of Appropriate Technology. This office is part of the Governor's Office of Planning and Research, and provides information on technologies that increase "self-reliance and community antonomy." OAT also encourages conservation and the use of renewable sources of energy. OAT also operates the Energy Extension Service, funded by the U.S. Department of Energy.

Governor Brown has appointed 25 persons to the Solarcal Council, which he has asked to develop a plan for "solarizing" California. The Solarcal Council has a 42-member Local Government Commission on Renewable Energy Sources and Conservation. Most members of this commission are local elected officials. The Business and Transportation Agency has a Solar Business Office, which promotes business use of solar energy.

In the transportation sector, the California Department of Transportation's District 4, the Energy Commission and the Metropolitan Transportation Commission have funded a non-profit corporation, RIDES, to promote vanpool and carpool use. MTC is also working with the regional transit operators in energy shortage contingency planning. This planning is designed to make maximum use of existing transit service in the event of severe gasoline shortages in the Bay Area.

The Energy Commission. In large measure, the creation of the Energy Commission in 1974 was a response to the lengthy hearings, delays, litigation and other factors that hindered the construction of power plants in California. In addition, California was forced to rely--for better or worse--on the forecasts of utilities in attempting to predict future energy patterns. Almost no research on energy development or conservation was funded by the State.

When voters created the California Coastal Zone Conservation Commissions by initiative in 1972, energy projects were only among many of the proposed developments to come under regulation. The new commissions spent many hours in making siting decisions for major energy projects. Utility companies began to complain about the Coastal Commission's permit process, and that they would be unable to satisfy the State's future energy needs unless a remedy was found.

The Legislature reponded with the Warren-Alquist Act of 1974, which created the Energy Resources Conservation and Development Commission. The commission was given the lead or "exclusive" responsibility for sitting of power plants and related facilities. However, the State Coastal Commission is still permitted to prohibit power plant construction in certain areas of the coastal zone that it has designated, and State law requires considerable communication between the Coastal and Energy Commissions prior to an Energy Commission decision on power plant projects within the non-designated areas of the coastal zone. In addition, the State Water Resources Control Board has adopted policies giving priority to the use of ocean water for cooling needs of power plants. The Department of Water Resources has endorsed this policy because of its responsibility for ensuring efficient operations of the State Water Project, and ensuring that California is adequately supplied with fresh water.

Another example indicating the Energy Commission's less than "exclusive" ability to site power plants is the requirement that plants meet local or State-imposed air quality regulations. The ability of the air quality agencies to dictate control requirements does constrain the Energy Commission's ability to site energy projects.

In its siting decisions, the Energy Commission must determine the need for new plants by comparing a utility's proposal with a commission forecast of demand. Considerable detail is required of utilities (such as PG&E) in preparing forecasts and other relevent information that would aid the commission in adopting its own forecasts and plans. Specific proposals must be reviewed for environmental impacts and for alternatives to the proposed plant. The commission uses an 18-month Notice of Intent (NOI) process to determine the need for the proposed facility, and appropriate site locations and facility types. This is followed by a second 18-month Application for Certification (AFC) process devoted to more specific engineering details of a utility's proposal.

The commission also has substantial involvement in conservation efforts, and the Warren-Alquist Act directed the commission to "encourage the balanced use of all sources of energy to meet the State's needs." In addition, the commission was directed to "seek to avoid possible undesirable consequences of reliance on a single source of energy." The commission is responsible for prescribing lighting, insulation, climate control systems and other building design and construction standards to increase energy efficiency. Minimum levels of operating efficiency for certain types of appliances are also being set by the commission.

The Public Utilities Commission. This independent agency of State government has as its main concern the setting of customer rates for electricity, and natural gas service. The PUC is required to adopt, and has adopted, lifeline rates for natural gas and electricity service to residential units. The commission also regulates intrastate natural gas pipelines and electrical transmission lines.

Prior to the creation of the Energy Commission, the PUC had issued certificates of public convenience and necessity required before any plant could be built. Athough these provisions of the Public Utilities Code remain on the books, the Warren-Alquist act preempts such activity to the Energy Commission, and the PUC's primary function is to regulate public utility rates. However, PUC is requested to provide the Energy Commission with comments or the design, operation, and location of proposed facilities as well as the economic, financial, rate, system reliability, and service implications of the facility. A certificate of public convenience and necessity is still required from the PUC. The certificate may not be granted prior to the Energy Commission's certification.

Local Government's Role in Energy

California's cities, counties and special districts operate within the general framework of State law. In general, charter cities may do anything with respect to their territory that their voters have authorized them to do and where the State Constitution doesn't expressly reserve a role to another agency. Several charter cities (for example, Alameda, Santa Clara, and Palo Alto) operate municipal power systems. General law cities and counties operate within the statutes adopted by the Legislature. A previous section described the range of energy

activities already performed by cities and counties under existing statutes. It is important in this section to conclude that local governments can encourage the development of new energy sources within their jurisdictions; many of them, however, do not wish to do so. But all can encourage conservation by existing and future residents and businesses; many are doing so.

Institutional Summary

As in many policy areas, decision-making in energy is fragmented. No one agency at any level of government is solely responsible for energy considerations. Moreover, because California has a lengthy history of creating single-purpose State agencies, those agencies tend to focus on meeting their single mandate to the detriment of other public policy considerations. Energy impacts are not always considered in making decisions about how to satisfy environmental standards, although the energy producers are expected to adhere to strict requirements for air and water pollution control.

Integrating energy considerations into environmental management decision-making will be an essential part of reducing energy demand in certain industries and providing facilities to meet the future energy needs of society as a whole. Explicit tradeoff mechanisms will be needed. These major factors will be addressed in the Regional Energy Plan for the Bay Area.

APPENDIX A

REVIEW OF THE LITERATURE ON ENERGY-ECONOMIC MODELING

The objectives of this literature review are to identify the unique and also the commonly occurring characteristics in energy modeling systems. The transferability of parts or all of the system to this region is also of major relevance, especially in relation to existing data, personnel, and modeling resources at ABAG. Although this review is not exhaustive it surveys representative examples in the cells of the matrix of inquiry. The ultimate purpose is to report the spectrum of modeling systems used in energy projections. These are used in the decision-making process leading to the formulation of energy policies that can guide a plan for regional energy management.

DIMENSIONS OF INQUIRY

Because of the large number of models that have been developed in the last decade, only a representative group can be examined and even fewer mentioned. The models have been classifed into a framework that emphasizes the characteristics most relevant to this inquiry. These characteristics include:

1. Geographic Scope
2. Time horizon
3. Comprehensiveness
4. Methods of analysis
5. Data availability
6. Validation and Calibration
7. Transferability

1. Geographic Scope refers to the spatial coverage of the model. Models are designed for national, state, utility service area, regional, SMSA, and county levels.

2. Time horizon varies significantly among the families of models. The variations in time include short range (1-2 years), midrange (5-20 years), and long range (20-50 years).

3. Comprehensiveness describes the degree of aggregation of the model. Models that incorporate the full framework of supply sources of all forms of energy to end uses as expressions of consumption are comprehensive. Some models cover customer classes individually: residential, commercial, industrial, transportation. Others deal with major fuel supplies and track these through supply channels. Incorporated into these comprehensive or disaggregated systems are submodels and relationships that are at a still smaller and more refined scale.

4. Methods of analysis incorporate the several forms of solution required by the projection system. These vary from simple linear trend methods to complex linked and integrated modeling systems. Included in these methods are trend and ratio schemes, simple and multiple regression, input-output, linear programming, engineering process descriptions, sets of econometric equations, and judgment exercise within accounting frameworks. [Greenberger, 1977].

5. Data availability interacts with model structure and geographic scope. Where a full catalog of data is available it is possible to design models that range as widely as the data. Limited data sources constrain the conceptual framework. In general, a wider range of data exists at the national level than at lower geographic levels, resulting in more comprehensive national models.

6. Validation and calibration are different stages in testing the model framework. Validation is primarily a test of the operationality of a modeling system; calibration follows validation and serves to fine-tune the operational model. Validation is carried out to adapt the model to the data base. It computes output to known information outside the scope of the test set of data, and uses tests of sensitivity to adjust coefficients and parameters.

7. Transferability has geographic and organizational dimensions. A modeling system designed for a particular state or region may have a structure that is usable in another area. In addition, the system should not be person-bound. Documentation and instruction should allow the model's output to be replicated by other analysts, technicians, and programmers.

TYPES OF ENERGY DEMAND MODELS

The impact of energy problems and issues in the real world has had its expected response in the laboratories of utility and business firms, the research institutes of academe, and the offices of government: a new cohort of energy models has been developed. In the period since 1975, a proliferation of modeling designs and experiments has generated comprehensive and particular mechanisms to aid in the evaluation of problems and the formulation of decisions that bracket the whole range of energy policies.

This section treats this population of models selectively, sampling representative members of the model population. Each model will be evaluated against the list of dimensions listed earlier, and unique characteristics will be added to that catalog.

Comprehensive (Integrated) National Models

A substantial number of documented energy modeling systems are designed to assist in national policy-making. At the Brookings Workshop in 1975 (National Science Foundation, 1975) five model structures were itemized

but at that time only one of the five had been adapted to the energy problem, and all were at the national level. This contrasted with the auspices of the meetings which called for "Modeling large scale systems at the national and regional levels."

The models presented were:

1. Wharton Econometric Model
2. INFORUM Input-Output Model
3. Strategic Environmental Assessment System (SEAS)
4. Mesarovic-Pestel Multilevel Regionalized World Model
5. FEA Project Independence (Blueprint) Model

The workshop had the effect of stimulating the adaptation and updating of these models so that by 1977-78, a new family of model names were in place, although several of them had roots that led back to the list above. Table 1, lists a "sampling" of the better known models, along with some of the uses served by the models, and the generalized methodology that was brought to bear upon their design. Careful examination of the uses demonstrates that most of the models were designed for national geographic coverage. The structure of several of these models will be reviewed later in this paper.

The phasing and elaboration of modeling sponsored by the U.S. Department of Energy is typical of the evolution of models in time. As referred to above, the 1975 modeling framework started with the FEA Project Independence (Blueprint) Model. This was soon superseded by a slightly modified system, the Project Independence Energy System (PIES). The Department of Energy [Energy Information Administration, 1979] soon began to generate a successor system, the Midterm Energy Forcasting System (MTEFS) which includes a wide spectrum of separate models including:

Structural Residential Use Model
Structural Commercial Use Model
Industrial Sector Econometric Model
Transportation Sector Model
State Level Transportation Energy Demand Model
Regional Energy Demand Forecasting Model (RDFOR)
Regional Energy Activity and Demographic Model (READ)
Multiregional Input-Output Model (MRIO)

Most significant is the emphasis given to regional activity in this development sequence.

<u>Regional Models</u>

Although several models have "regional" in their names, the geographic scope of their design varies from groups of states, to individual states to extensive service areas across state lines and within states to SMSA's. In addition to the purposes for which the models is being used, a related constraint is the availability of data. A significant number of energy models at geographic levels below nation-wide scope were

TABLE 1

MODELS, METHODOLOGIES, AND USES

Model	*Supply Side*	*Demand Side*	*Uses*
Adams-Griffin	Optimization	Econometric	Strategies for oil refinery pricing
Baughman-Joskow	Optimization	Econometric	Energy-economic effects of nuclear moratorium in California
Bechtel Supply	Accounting	Exogenous	FEA studies of industry requirements for energy expansion
Brookhaven (Hoffman)	Optimization	Exogenous	ERDA evaluation of alternative energy technologies
Coal 1 (Naill)	System dynamics	System dynamics	Congressional hearings on energy forecasts
DRI-Brookhaven*	Optimization	Econometric	ERDA studies of economic impact of alternative energy futures
Dupree-West	Exogenous	Exogenous	Department of Interior long-term energy forecasts
Emergency Energy Capacity	Optimization	Exogenous	Office of Energy Preparedness and Treasury Department storage option studies
ETA and ETA-Macro (Manne)	Optimization	Informal econometric	Studies of nuclear alternatives (Ford-Mitre Committee on Nuclear and Alternative Energy Systems)
FEA Short-Term Petroleum	Optimization	Econometric	FEA studies of oil embargo
Hudson-Jorgenson*	Econometric	Econometric	Impact of reduced energy consumption on the economy (Ford, EEI).
Hynilicza*	Econometric	Econometric	Alternative strategies for optimal economic growth
Illinois Input-Output (Hannon and Bullard)	Econometric	Exogenous	ERDA studies of energy conservation.
Kennedy-Niemeyer*	Econometric	Econometric	Macroeconomic effects of a nuclear moratorium in California
Lawrence-Berkeley (Glassey)	Optimization	Partial optimization	EPRI industry studies.
MacAvoy-Pindyck	Econometric	Econometric	White House analysis of gas deregulation
Nordhaus Bulldog	Optimization	Econometric	Energy economic impact of alternative nuclear and fossil fuel strategies (Committee on Nuclear and Alternative Energy Systems).
PACE	Optimization	Exogenous	Energy sector studies with emphasis on petrochemical industry.
PIES	Optimization	Econometric	National energy plan and FEA studies of oil and natural gas price decontrol.
PILOT (Dantzig)*	Optimization	Partial optimization	Exploration of potential energy-economic growth
SEAS (House)	Exogenous	Exogenous	Economic and environmental impacts of alternative energy futures
SRI-Gulf (Cazalet)	Process representation	Informal econometric	Gulf Oil Co. and White House decisions on synthetic fuels
TERA (Limay)	Optimization	Econometric	American Gas Association natural gas studies
Wharton (Klein)*	Econometric	Econometric	Congressional hearings on Carter energy plan

*Models used in the first study of EPRI's Energy Modeling Forum project

Glossary

Accounting Charts of requirements and characteristics displaying numerical relationships

Econometric Mathematical (difference) equations solved simultaneously with coefficients estimated statistically from historical data

Exogenous Given or assumed, rather than calculated (endogenously) within the model

Optimization Determination of "best" solutions by means of algebraic procedures

Process representation Description of energy processes and markets in the form of a hierarchical network

System dynamics Mathematical (integral) equations solved recursively with coefficients estimated judgmentally from the modeler's experience and intuition

Source: EPRI JOURNAL October 1977

discussed in the Electric Power Research Institute's Symposium held in December 1977 [EPRI Symposium Procedings, 1979].

Several problem areas surfaced at these meetings. With regard to data, it was reported that:

> "The quality and quantity of small-area data are serious problems...Governmental efforts at data collection are generally undertaken on a sampling basis that is representative of the nation, perhaps states, and possibly SMSAs. At the county level, relatively little solid information exists other than what the utilities can obtain themselves...
>
> "A second problem... is that even if high-quality data were collected frequently on all of the variables that electric utilities could use..., governmental organizations collect data according to governmental units, and electric utility services areas only rarely follow boundaries of any governmental jurisdiction whatever...
>
> "...a further problem...(is that) the quality of the forecasts of service-area economic activity that are inputs to the forecasts are likely to be in serious error... regional economic growth models are frequently unsophisticated, not only because of the quality of the data but also because of the state of the art itself...
>
> Finally, "forecasting models themselves need to be made better and more useable...a better model is one with sounder conceptual foundations, increased accuracy, and increased flexibility in answering "what if" questions...the obvious way to create such models is through analytical sophistication, more detail, increased data of better quality, more powerful computers, more highly trained staff, and more time...it is unlikely that all these conditions will ever be met for most utilities..." [EPRI Symposium Proceedings, 1979, p. xii]

Model Structures

The structures of energy models, and in fact, all models, reflect first of all the objectives for which the model is being designed. Beyond that, however, the design is influenced by the style of the designer or design team. And an overriding constraint is the availability of required data. Finally, the costs in terms of financial and human resources have to be brought to bear upon the modeling effort.

In this section, two comprehensive energy-economic models are described primarily to identify the major components that they have in common, and to contrast those elements in which they are unique. Then, a somewhat parallel treatment will be followed with regard to an integrated regional model and to models of disaggregated energy sources and end-uses.

The Wharton Annual Energy Model

One of the most comprehensive and elaborate models directed at energy policy issues is the Wharton Annual Energy Model [Wharton E.F.A., 1979]. This model is a modified version of the national macro-forecasting model of Wharton Econometric Forecasting Associates (WEFA) where the energy-focused modifications enlarge upon the basic model's treatment of energy issues.

A simplified diagram of the model's structure is presented in Figure 1 [MIT Energy Laboratory, 1979, pp. 5-7]. Estimates of final demand components drive an elaborately structured input-output (I-O) model. The I-O model generates outputs for 59 disaggregated industrial sectors which are linked with price and wage determination models and with a model generating labor requirements.

Labor requirements are compared with exogenously provided population and labor force quantities to determine unemployment. Unemployment, along with prices, wages, and interest rates, feeds back to final demand. The Energy Version of the model respecified the sectors of the I-O table to expand the energy-supplying and energy-conserving industries. Engineering process models were integrated into the structure. In addition, several satellite models were also linked to the system to provide effective feedback between the sector models and the national model. Specific satellite models were the Coal Satellite Model, the Pseudo Data Electric Power Cost Function, and the FEA Residential Energy Demand Functions.

The complexity of this modeling system was able to be designed because of the congruence of the data requirements with national sources growing out of the federal statistical establishment. In addition, very sophisticated analytical methods were developed and used to modify and update the coefficients of the I-O model and the parameters of the other integrated models of the system.

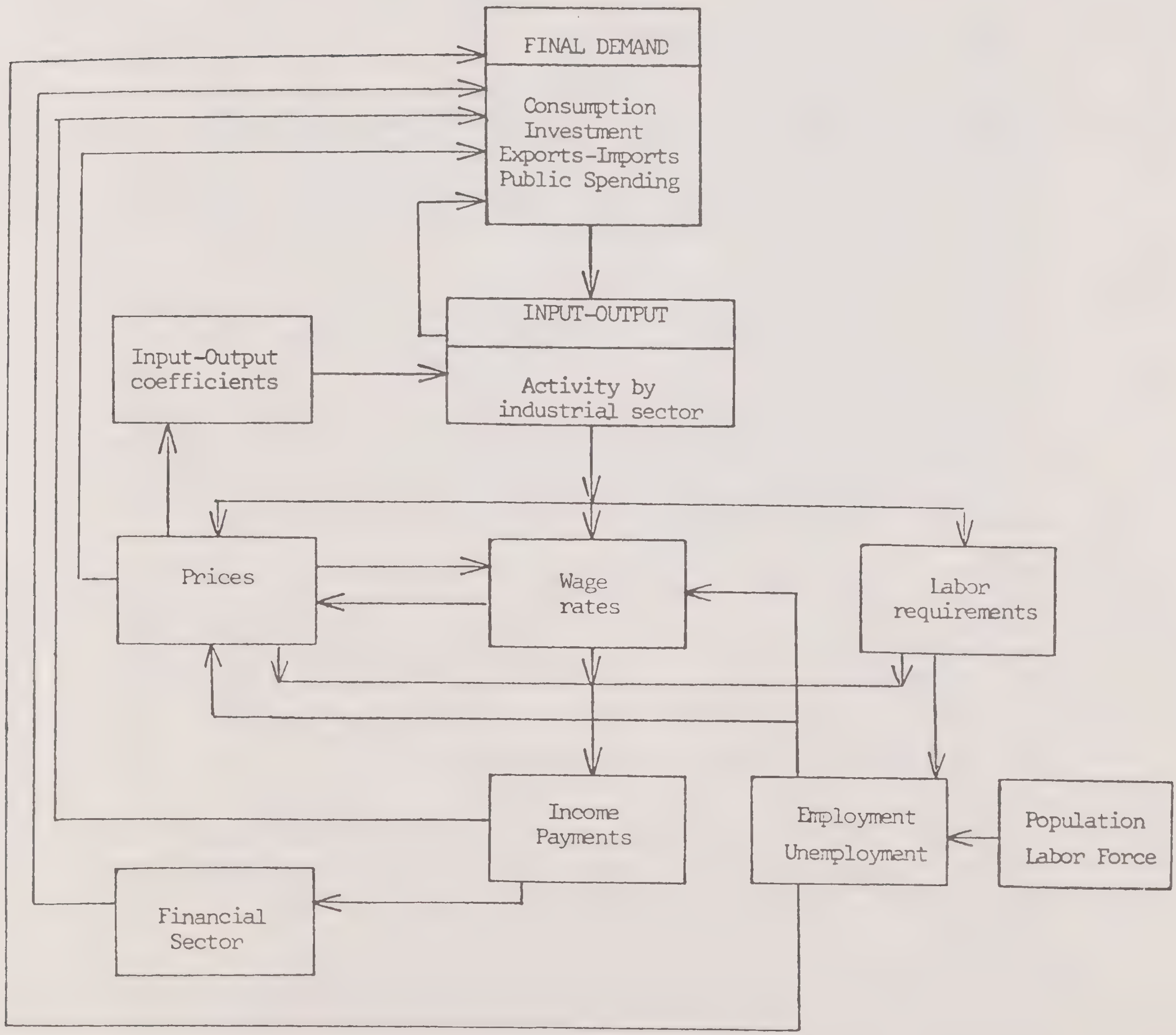
An attempt to assess the operation of the Wharton Energy Model was made by the Electric Power Research Institute (EPRI) but the proces apparently ruffled some feathers. The Wharton model was still in process of modification during the evaluation process and the evaluations could not deal with a constantly shifting target for their assessment. The outcome of this contretemps was that a separate descriptive monograph was published by EPRI [Wharton E.F.A. Inc, 1979] which was prepared by WEFA without the evaluative comments of the assessment organization and its evaluators.

Summarizing the components of the Wharton Energy Model, there are:

1. A complex and finely disaggregated input-outpout model which endogenously updates the interindustry coefficients, and incorporates detailed exports, imports, fixed investment, and government sectors demand;

Figure 1

Simplified Flow Diagram of the Wharton Energy Model



2. Exogeneously determined population, labor force, and final demand estimates;

3. An elegant mechanism for wholesale price determination based on sector labor and capital costs;

4. A set of satellite models directly applicable to energy policy issues including a coal satellite model, a large process model of the electric utility industry, and a model to generate residential energy demand.

The Regionalized Electricity Model (REM)

The Regionalized Electricity Model (REM) is a system developed by Professors Baughman and Joskow at the Massachusetts Institute of Technology (MIT) Energy Laboratory [MIT Energy Laboratory, 1979]. The regionalized aspect of the model's name clearly applies to the Census Regions concept of groups of states rather than regions or SMSAs within states. The implementation described in the EPRI Assessment is for the state of New York.

The diagram in Figure 2 shows the major components of the model which are: (1) a demand submodel structured around regression methods, applied to two major user classes, residential/commercial and industrial; (2) the supply submodel is more elaborate, simulating the behavior of the utility industry including choice of generating plants, investment in new capacity, incurring of operating costs for transmission, distribution, and general overhead, and management of financing; (3) the third major component is a unique submodel reflecting regulatory actions and decisions and their impacts on the system.

As shown in the Figure 2, the three models require exogenous inputs on population, economic trends, climatalogical data, interest, depreciation, and regulated rates of return, along with resource supply and production characteristics. This compendium of exogenously supplied data constitutes a substantial burden on external models which must be integrated with the core system.

Regional Residential Demand for Electrical Energy

Shifting our attention from the national level to the region, and to particular sectors of energy demand, selection has been made of a complex regional residential model of electricity demand used by the Northeast Utilities (NU) for forecasts in Connecticut and Western Massachussetts [EPRI Symposium Proceedings, 1979].

Although NU uses econometric approaches for short-run forecasting, the primary emphasis here is on the long-run where the conceptual framework emphasizes systems simulation. The long-run residential system uses four separate models: (1) an economic/demographic model which provides population projections; (2) a housing unit model which provides single-multiple housing unit breakdown; (3) a residential sales model forecasting electricity sales; and (4) a residential peak-day load model

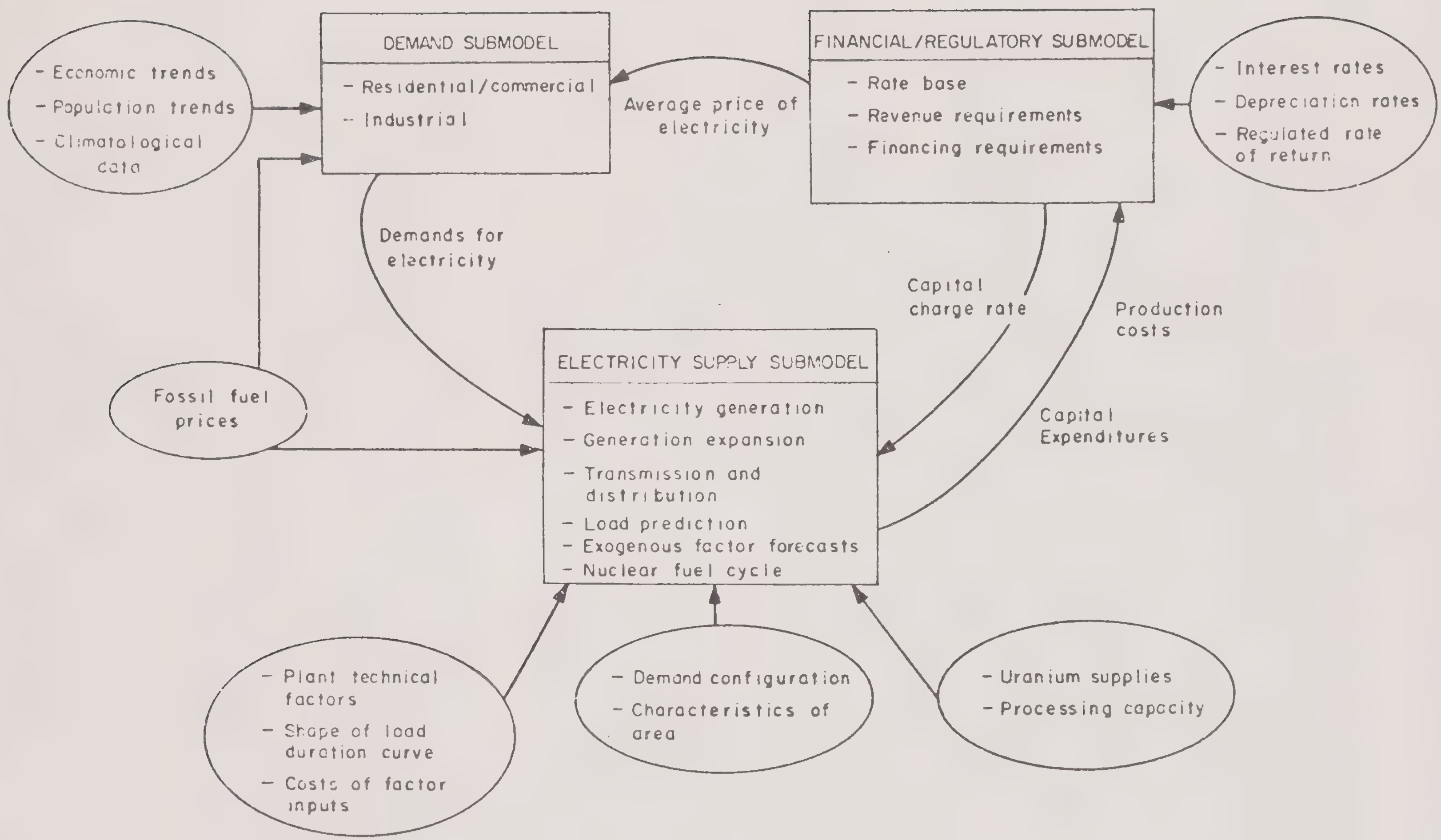


FIGURE 2. SCHEMATIC OVERVIEW OF THE STRUCTURE OF THE BAUGHMAN-JOSKOW MODEL

which calculates hour-by-hour load of the residential class on the day of the system peak demand.

The economic/demographic model can be considered a prototype of integrated model for providing population and economic activity in an internally consistent fashion to drive the models linked to it. The demographic sector is conventionally modeled using the cohort survival technique. The levels and trends of birth and survival rates are fed into the model, and the program executes the necessary interpolations and updating. The net migration assumptions are also carried out for three cohorts, migrant children 1-14 years of age, people of prime employable age, and those near and after retirement.

The economic activity model generates employment as the sum of manufacturing, nonmanufacturing, and other industry employment. Manufacturing employment is projected for fourteen of the most important SIC industries calibrated to a growth rate trended to the log of time. This systematically weights the near years more significantly than the more distant future years in fitting the growth trends.

Nonmanufacturing employment is projected for seven one-digit industry sectors as trends fitted to log of time and weighted to reflect the importance to that sector of the mix of population and employment in the region. These weights are exogenously provided for each sector.

The residual "other" category is a weighted average of growth rates established above. Most industries are subject to industry-specific growth multipliers to reflect local conditions, which in turn are reflective of a cost index. The cost index explains why local industry growth rates differ from the actual rates, and also allows alteration if costs are expected to change. The cost index reflects the costs of labor, transportation, taxes, and energy in the region relative to national costs.

The housing unit model starts with the application of headship rates in each age-sex cohort of the demographic model. These estimates of household/housing units generate net housing demand. Total housing units constructed are the sum of the increment in households plus replacement demand plus demand for second homes. The latter two sources of new construction are assumed to be constants, 0.4% per year for replacement and 1.9% per year for second homes. Vacancy rates have been treated implicitly in the model because of their instability. The breakdown of housing units into single and multi-family units uses a simplified approach based on the trend and levels of building permits of single-family units averaged over the service areas for the more recent years 1970-75.

The residential (electricity) sales model employs the forecasts of new housing units and estimates the annual use of 16 specific types of appliances plus a residual miscellaneous category. The stock of each appliance is carefully estimated taking into consideration its average useful life, additions to the stock in the new housing market, the replacement market, and the existing market. These are conditioned by

efficiency of new appliances and changing standards of saturation (appliance/housing unit).

Efficiency, average use per appliance, and saturation are coefficients to the system for which careful, intensive study and estimation are carried out. Surveys of residential customers, use of governmental and industry efficiency standards, and factors influencing average use are brought to bear for each appliance-type.

The Residential Peak Day Load Model

In order to implement the time-of-day rate structure, widespread interest in peak load demand has been expressed by utilities, their customers, and regulatory bodies. Models to estimate peak hour demand and impacts on revenues have been developed and integrated into forecasting systems. The NU system's peak load model is linked to the residential sales model using the end-use appliance loads generated by that model. The hourly pattern of use for each appliance type is generated by a set of hourly demand factors conditioned by the rate schedule (conventional or time-of-day) to which they are subject. A very detailed data and analytic process undergirds the establishment of the hourly demand factors for each appliance type.

Commercial Forecasting Models

Models of the commercial sector pose a classification problem for model description and evaluation. Most utilities define "commercial" as a category that fits their service functions rather than the industrial class of the user. Thus, Consolidated Edison defines "commercial" as a combination of commercial and industrial customers. Houston Light and Power (HL&P) includes larger office buildings, larger stores, fair-sized manufacturing plants, larger pipelines, and a great many master-metered apartment units.

The models developed for this sector are regression models used by HL&P in their forecasting program [EPRI Symposium Proceedings, 1979, pp.9-1ff]. Because regression models are unique to each area, the Houston coefficients are of incidental value and therefore, only the explanatory variables are discussed here.

The dependent variable is monthly kilowatt hour sales to the commercial customers as classified by the utility. The independent variables are:

- cooling degree-hours x customers
- heating degree-hours x customers
- total real disposable income
- real price of electricity-current month
- real price of gas
- billing month length x customers

As can be observed, the model deals with weather variations, real disposable income, prices of electricity and gas, and adjusts for variations in the length of month.

It is interesting to contrast the structure of this equation with the demand relation emplaced in the REM system previously described [MIT Energy Laboratory, 1979, pp. 3-5]. In that model, the dependent variable is log (energy/population) and the independent variables are:

personal income/population
minimum temperature
population/area
average price
log (energy/population) in previous period

This is carried further to identify fuel split as a function of price ratios of competing fuels, maximum and minimum temperatures, and a lagged value of the dependent variable.

A commercial model emphasizing end-use concepts has been adapted by the staff of the California Energy Commission (CEC) for their use in statewide and regional forecasting [California Energy Commission, 1979]. Eleven building types are identified for which floor space measurements are separately estimated:

1. Offices
2. Restaurants
3. Retail
4. Groceries
5. Warehouses
6. Elementary and Secondary Schools
7. Colleges and Trade Schools
8. Health
9. Hotel/Motel
10. Miscellaneous
11. State Offices

For each building type, eight end uses are established for which the number of BTUs per unit of commercial floor space is calculated:

1. Space Heating
2. Air Conditioning
3. Ventilation
4. Water Heating
5. Cooking
6. Refrigeration
7. Lighting
8. Miscellaneous

Basic fuel types are also integrated into this classification by estimating the percentage of floor space allocated to each fuel type:

1. Electricity
2. Natural Gas
3. Other (Mostly Oil)

The model also considers the effects of changes in real per capita income, population, and building and appliance standards on energy use. CEC asserts that "the forecast is without precedent as to level of detail as well as extent and quality of input data."

Transportation Forecasting Models

In reviewing the literature covering energy policy models, including those that purport to be "integrated" and "comprehensive", a significant gap occurs for personal transportation. Some of the models cover transportation industries; others subsume personal consumption of gasoline within aggregate models for fuel types. It is possible that the conceptual difficulties are part of the problem, for the analytical methods well developed in transportation planning require a different methodological approach than the modeling systems already described.

The pattern for policy analysis in personal transportation demand is defined and analyzed in a series of studies accomplished for the U.S. Department of Energy [Suhrbier and Byrne, 1979] in connection with the U.S. Department of Transportation. Analytical systems were developed to satisfy five criteria. They should:

1. Be capable of dealing with a large number of policy types;

2. Predict the relevant impacts and their incidence across geographical, socioeconomic, and governmental units;

3. Be capable of predicting the synergistic (and competing) interactions of energy conservation actions;

4. Provide different levels of analysis capability;

5. Be adaptable to different levels and types of data available within an urban area;

6. Be inexpensive and quick to apply.

The analysis methodology that conforms to these criteria involves the use of "disaggregate travel demand" models and random household sample enumeration techniques. An integrated computer-based system of separate models, referred to as Short Range Generalized Transportation Policy Analysis (SRGP) has been devised to meet these criteria. The SRGP models listed below are estimated as multinomial logit functions:

1. Vehicle emissions (CO,HC,NOx) as a function of travel speed, vehicle year, cold start and other factors accounted for in EPA's AP-42, Supplement 5 publication;

2. Vehicle energy consumption as a function of travel speed, vehicle year and weight, and cold start;

3. Automobile ownership for households have 0, 1, 2 workers;

4. Social/recreational trip destinations and modal choice;

5. Shopping trip distribution and mode choice;

6. Household work trip mode choice for drive auto alone, shared ride, and transit. The primary worker is differentiated from other household workers.

Regression (linear and nonlinear) is used as the estimation method in the following SRGP models:

7. Shopping trip frequency;

8. Social/recreational trip frequency;

9. Carpool size;

10. Automobile cost;

Integrated Forecasting Models

Forecasting methods which combine several customer classes depend primarily on "adding up" the projections of each class. A system that exemplified this type of integration is of interest because of the structure of components that are used for each customer class, and for its applicability to any geographic unit. Summarized here is an integrated system framework that is attributable to Gilbert Management Consultants (GMC) [EPRI Symposium Proceedings, 1979 pp. 18-1 ff.]. The customer classes used in the GMC overview are the conventional ones: residential, commercial, industrial, other.

The residential forecast can be characterized as an end-use appliance stock model. The end uses are generated by submodel for:

population/migration/employment
household/housing characteristics
appliance stock
appliance energy consumption

These sectors embody concepts that were discussed earlier in the Regional Residential Demand Model used by Northeast Utilities.

In the GMC overview, the commercial energy forecasting mechanism is characterised by customer diversity and a relative lack of detailed statistics, and as a result has proved to be the most difficult to model. GMC suggests that the methodology must be established on a case-by-case basis depending on data availability. Their approach embodies a partitioning out of large commercial establishments and treating their known and anticipated plans individually. The remainder of commercial uses are estimated by a simplified framework of commercial end-uses, starting with space-heating, and combining all other end-uses. Regression equations depending on households or population, income per household, price of electricity, and cooling degree days are developed.

The GMC approach also embodies an industrial sector. Here uses are considered to be a function of production levels in the short-run and production levels plus technological changes in the long run. Disaggregation to individual industries is carried out with special attention to the identification of large individual customers and the most important industries in the region. Each of these is evaluated for production levels and energy intensiveness.

Other customer classes incorporate uses for street and outdoor lighting, sales to other public utilities, sales for resale, and company use.

In addition to integrating these customer classes by the adding up process, GMC develops outputs in a peak load model using the outputs of the individual customer classes in order to be able to test time-of-day rates and their impacts on demand and revenues.

CONCLUSIONS

In summarizing the inferences gleaned from this review of energy models and their structures, it is appropriate to keep in mind the comments of Kuh and Woods, in their Independent Assessment of Energy Policy Models (1979):

> "...The potential contribution of energy policy models is not yet fully realized...First, the expectations of those sponsoring development of policy models may not correspond to reality. Second, modelers may lose sight of the policy issues...as contrasted with the technical aspects of the underlying reality being modeled. Third, the need for organizational initiatives that facilitate communication between modelers and model users in both the model development and policy research process may not be realized. Finally, procedures for model review and assessment may not be sufficient to satisfy model users...as to the model's credibility" [Kuh and Woods, 1979, p.S-1].

With these words of caution regarding the policy uses of energy models (and of all models), let us turn to the generalizations that emerge from this short overview of the energy modeling literature.

1. Although there are a wide range of model types designed for energy forecasting and policy assessment, virtually all of them are driven by a combination of demographic and economic models scaled to the geographic area of concern.

2. The economic models used as an integral part of the projection system are, by and large, simple trend equations for disaggregated industrial categories. The major exception is the Wharton Energy Model which is built around an elegant and advanced input output

framework of models at the national level. There is an opportunity to test this approach to the regional level.

3. Energy demand models for the residential sector have been developed to incorporate a wide range of appliance end uses. This allows the estimation of market penetration, average usage, and changing efficiency levels for the large number of appliances used in the representative household.

4. Commercial and industrial energy demand models at the regional level are extremely elementary, consisting of trend regression equations adapted to the available data. Here, the major exception is the model adapted for use at the California Energy Commission. This model utilizes an imaginative catalog of disaggregated end uses in its operation, allowing for much more sensitive policy testing.

5. With the exception of some aggregated treatment at the national level, there seems to be very little modeling concern with the voracious demand for energy generated by personal transportation. Fortunately, this gap is filled by a system of models developed for the U.S. Department of Energy collaboratively with the U.S. Department of Transportation. These models, referred to as the Short Range Generalized Transportation Policy (SRGP) system, are based on the travel behavior and preferences of individuals. This allows aggregations to be made for a variety of geographic areas, travel modes, and transportation determinants. Travel demand estimation and forecasting with SRGP constitutes the current state-of-the-art for efficient, easy-to-use, adaptive policy assessment.

6. Data at the regional level is a major problem for model users and model designers. Every detailed discussion of energy modeling systems emphasized the constraints imposed by lack of data, along with its spatial mismatch, definitional inconsistencies, and long lags in becoming available.

7. Several unique characteristics of the modeling framework appear as the model structures are reviewed.

    a. The REM model is distinctive in its treatment of financial and regulatory mechanisms within the modeling system.

    b. The more sophisticated residential demand models include hour-of-day peak load demand submodels, reflecting the great interest in hour-of-day pricing and its impact on utility revenues.

c. At the regional level, "integration" of customer classes consists of no more than adding up seperate submodels. The possibility of interactions and feedbacks, even if only for tests and experiments, are not part of the utility company's agenda for the future.

d. The importance of including prices as variables in the economic models is recognized, and several approaches are attempted in the models. Most of these encounter the problem of projecting price levels into the future.

Applicability of Models and Approaches to Bay Area and ABAG

The national models, by definition, are not transferable to the regional level. Nevertheless, those modeling systems that have been examined demonstrate several concepts that merit introduction at the regional level.

1. The extreme adaptability and comprehensiveness of the input-output framework would be of special value to the region's modeling system;

2. The direct policy guidance of a financial-regulatory component within the modeling framework warrants examination of that concept from REM;

3. The incorporation of price and price adjustment mechanisms against the background of inflation and the uncertainty regarding its future trend is of vital importance, as exhibited in the Wharton Energy Model.

The regional models examined set a standard that should be matched, either by transfering models or modifying the ABAG modeling system.

1. The regional demographic models included projection methods that generated annual data for each of the age-sex cohorts. In addition, there were several alternative methods of projecting migration that merit examination and comparison with the ABAG demographic model;

2. The regional economic models also were more elaborate than the ABAG economic framework. Not only did they include more industries, but also, price levels by industry were included to modify the specific industry ouputs in a simple but conceptually persuasive process;

3. The design of regional energy demand models for the residential and commercial sectors, using appliance end-uses and other end use variables can follow the

prototypes designs that have been mentioned in the review;

4. The industrial sector is very simply structured in the review, and an opportunity for experiment exists;

5. The separate treatment, or casual interest in personal transportation, also suggests that innovative possibilities exist and the opportunities should be exploited.

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APPENDIX B

DESCRIPTION OF THE REGIONAL ENERGY-ECONOMIC INFORMATION SYSTEM (REEIS)

The Regional Energy-Economic Information System is designed as an interactive computer based simulation system providing energy, economic and demographic information at the regional level. The energy component is designed to provide aggregate energy consumption information in BTu's for residential, commercial, transportation, and industrial consuming sectors. Because of the design of the industrial energy consumption model, data are disaggregated to a level consistent with the Standard Industrial Classification (SIC) categories in the economic model. The economic model provides gross output information, employment requirements, personal consumption expenditures, and per capita income data. The demographic model which interacts with the economic model provides data on population and labor force. This is considered a first-generation system with respect to energy modeling for the San Francisco Bay Region. Figure 1 defines the relationships between the components of the REEIS (Regional Energy-Economic Information System).

Industrial Economic/Energy Model

The Industrial Economic/Energy Model is structured around an input-output model for the nine-county San Francisco Bay Region. An input-output model model is a representation of product sales and transfers in the region. Its great advantage over highly aggregated models is that it shows much more than sales to final users by a given sectors. It shows sales to all intermediate customers that supply the final Demand sectors. Final demand sectors in model consists of the demand for goods by Households, the government, investment requirements and exports to the rest-of-the-world.

The economy is driven by changes in the demand by the above elements. These sectors are estimated by use of Census Data, information by the California Employment Development Department and selected survey information. The model uses the 1972 national input-output model updated to 1977 and adjusted to reflect the regional trade flows in the nine-county area.

The production of goods and services by industries in the model relates changes in final demand to total output requirements needed to meet final demand.

In turn, changes in output levels are translated into changes in industry requirements for fuel, labor, other material inputs, and output of pollutants. The system design permits impact analysis. This analysis is based upon linkages among local industries, and define the extent of the "ripple" effect of the entire economy originating from a change in the level of activity of any one industry. Labor productivity and energy requirements per unit of output translate the multiplier effect into labor and energy units. Although not part of the Industrial

Economic/Energy Model proposed for this study, the system is designed to be extended to include an optimization procedure which permits the industrial model to be redesigned to maximize either gross regional product, employment, or such other objectives subject only to the constraints of capital, energy, and material resources. The objective of this approach is to further permit a broad assessment of potential public policies that would affect the economic development of the region.

1. <u>Direct Requirements--A First Measure of Interdependencies</u>

The transactions table which reflects the demand for and supply of goods by industry allows measurement of first order interdependencies among sectors of the economy. The ratio of individual industrial purchasers to total output of producing sectors:

$$A_{ij} = \frac{X_{ij}}{X_j} \tag{1}$$

where: X_{ij} = intermediate product purchases of j^{th} sector from the i^{th} sector;

X_j = gross output of j^{th} sector;

A_{ij} = intermediate product purchases per dollar output of j^{th} sector from the i^{th} sector.

is used to define a linear production function for each industry:

$$X_j = \sum^{i} A_{ij} X_j + \sum^{s} A_{sj} X_j \tag{2}$$

where: A_{sj} = primary input of class s per dollar output of j^{th} sector.

When transformed into common dollar basis, internal differences in structure among producing sectors appear.

2. Direct and Indirect Requirements--Demand Multipliers

The ripple effect of a demand change on the whole economy can be demonstrated through the use of demand multipliers. These are derived from the initial distribution.

$$X_i = \sum^{j} A_{ij}X_j = \sum^{k} F_{ki} \tag{3}$$

where: F_{jk} = sales to final demand of class k by producing sector i; (4)

and

$$X_i - \sum^{j} A_{ij}X_j = \sum^{k} F_{ki}. \tag{5}$$

This shows that an increase in final demand for the output of an industry will require an activity level high enough to produce both the required increase in final output of that industry and incremental intermediate products to related industries in the area.

After conversion to matrix form and transposition of terms,

$$[X]_{nx1} = [I-A]^{-1}_{nxn} \; [F]_{nx1} \tag{6}$$

where: $[X]_{nx1}$ = vector of industry outputs; (7)

$[A]_{nxn}$ = matrix of inter-industry coefficients, Aij; (8)

and: $[F]_{nx1}$ = vector of total final demand. (9)

The matrix $[I-A]^{-1}$ calculates the required change in output of all industries resulting from a change in final demand of any one industry. Hence, this matrix is referred to as the set of demand multipliers. It provides analysts and planners a method for measuring the effect of changing markets for finished products on the whole economy.

The value of the demand multipliers depend on the proportion of local purchases to total outlay (gross output). In a self-sufficient economy a change in activity level of one industry affects all other industries

through their purchasing relationships, in effect causing large changes in total economic activity.

3. Industrial Energy Demand

The demands for energy in manufacturing stems from the demands for the product the energy is used to produce; in technical economics, the manufacturing demand for energy is a derived demand. Several factors influence the demand (or the intensity of use) of energy use in manufacturing. One factor is the responsiveness of the sales of a product to final demand users to changes in energy prices. If a product is highly elastic in terms of sensitivity to price changes, a manufacturer will probably reduce his total energy use according to how far his sales will decline when he passes on the energy cost to his buyers. Further, a rise in the price of energy will reduce a manufacturer's demand for energy depending upon the substitutability of other productive resources, such as more efficient capital equipment, for energy. Increasingly, manufacturers are using processes that offer efficiencies in the recovery of waste heat, or reuse of wastes to produce energy.

Estimating energy use in manufacturing, therefore, requires as an initial element the estimation of energy use coefficients for each SIC sector in the Input-Output Model manufacturing sectors. This is accomplished for the base years by using estimates of fuel use from the 1977 Census of Manufacturing by SIC sector in the Input-Output Model.

Dividing fuel used in Btu values by Total Gross Output in dollars renders estimates of fuel use per $ of Gross Output for the base year. This variable is called the Energy Coefficient and is expressed as CEit. This expression is multiplied by the right hand side of expression (5), which results in:

$$E_{it} = \left[Ce_{it}(I-A)^{-1} + S_i \right] FD \qquad (11)$$

where: E_{it} = energy of type i required to produce gross outputs that will satisfy final demands. (12)

Ce_{it} = diagonal matrix of energy coefficients for type i for all producing sectors (e.g., Btu/$ output). (13)

S_i = a residual which accounts for energy produced within the production process of the sector and not bought to produce the gross output. (14)

The requirements of energy to produce the forecast output follows established procedures for estimating the industry demand for energy.[1]

The variable (CE_{it}) in this system is a function of the change in energy intensity required to produced a gross output. In the base year, this variable is expressed as 1.0 and changes over time given changes in energy prices, capital equipment, interest rates, and governmental regulations. Mathematically, this expression is presented as:

$$E.I_0 \, (e^{-gt}) \tag{15}$$

where: $E.I_0$ = base year intensity variable, usually expressed as 1.0

g = f(prices, technology change, interest rates, governmental regulations)

t = forecast year - base year

Equation (7) is then multiplied by CE_{it} to obtain the change in the Btu/output due to changes in energy intensity of the production process.

The forecast year energy coefficient and the new final demand estimate for the manufacturing sector are applied to equation (6) to obtain the gross energy necessary to meet the forecast demand for manufacturing good for the forecast year.

Research generated in the Energy Impact Assessment of Environmetal Regulatory Constraints in the overall work program is used in the industrial I/O sectors to generate potential energy conversion losses or gains in the production process. The variable (CE_{it}) is disaggregated in specific industries to reflect energy used to produce an output, and energy lost in the conversion process produce the same output.

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1. This procedure suggested by Folk and Hannon in the publication, "An Energy, Pollution and Employment Policy Model," Hugh Folk and Bruce Hannon," CAC document #68, Center For Advanced Computation, University of Illinois, Urbana, Ill. Feb. 10, 1973, suggests that if CEit is used as a diagonal matrix instead of a row vector then energy requirement are obtained as a column vector representing the energy required in each industry as a consequence of the specified final demand.

A measure of efficiency which reflects the gain or loss in conversion efficiency is calculated for environmental regulatory constraints. For example, a loss in conversion efficiency would require a larger (CEit) reflecting an increase in energy required per unit of output. This process provides the user of the system with a generalized understanding of the short-term impacts of environmental regulatory constraints assuring no change in technology that would improve efficiency, generally lower pollutant magnitudes and decrease energy input requirements.

Data generated in the Regional Economic Input-Output Model is used as input information into the residential, commercial, and transportation energy consumption models. This permits a consistency across each model in forecasting changes in total energy requirements, and increases the capability of the total system to reflect changes in national and regional economic conditions that affect local consumption.

Residential Energy Use Model

The residential energy use model is divided into three components which comprise the sum of energy consumption in the residential sector. These submodels are (a) space heating and cooling; (b) residential water heating; and (c) energy appliance use.

The Space Heating and Cooling Models are a functional of (a) degree days, (b) households, define (c) energy requirements of the appliance (d) housing type expressed in square feet, (e) price of energy, and (f) fuel type and energy of the appliance. Saturation level in this system implies the percentage of total households who have air conditioning units in their housing unit. The modeling structure permits the user to input assumptions on an annual basis concerning changes in demographic, economic, and public policies that influence efficiency of space heating and cooling in the dwelling units.

The Residential Water Heater sub-model considers the demand for hot water by appliance type. The demand is a functional of: (a) the saturation level, (b) the efficiency of the applicance and the hot water heater, (c) the price of energy; and (d) the income and number of households in the region.

In the appliance sub-model, the design permits energy forecasts by appliance type. Reflecting changes in the above, model design in the system permits the user to input changes on an annual basis for impact assessment in terms of energy use in appliances.

Each sub-model permits the flexibility necessary to assess changes in demand as a function of policy and market conditions.

Commercial Energy Use Model

Critical to forecasting commercial energy use is the development of a system that ties the growth in the regional economy to the demand for building types. This model forecasts the demand for commercial, educational, and public buildings as an initital step in determining energy demand in the commercial sector. Each building type has energy requirements translated into Btu's/sq.ft. Saturation, fuel type and energy required/appliance type change annually through changes in prices, efficiency standards and existing building inventory Saturation and intensity factors interact with six categories of energy usage by building type to provide aggregate estimates of energy consumption in the commercial sector.

Transportation Energy Consumption Model

Demand for fossil energy in transportation is forecast for autos, trucks, and other urban vehicles. The individual vehicle type forecasts are aggregated providing estimates of energy use in the entire sector. The methodology for forecasting transportation energy demand has not yet been detailed. But broadly speaking, the process requires the following data. For automobiles these data consist of the following: gasoline prices are projected in terms of the real gas price. The real gas price is expressed by the following ratio:

$$\text{Real Gas Price} = \frac{\text{Current gas price (\$/gallon)}}{\text{Fleet fuel economy (mpg)}} \tag{16}$$

Non-fuel operating costs are estimated and the sum reflects the total cost of operating a vehicle. This variable is adjusted to reflect saturation in automobile expenditures. Next, travel demand expressed as person miles/capita for each year is estimated. The travel demand for year (t) is determined by the expression:

$$T_{Dt} = T_{E_t} \left(Lf_t / Tc_t\right) \tag{17}$$

where: T_{D_t} = Total demand per capita in year t

Lf_t = Load factor expressed as person miles

Tc_t = Total operating cost

Next, an estimate of Btu per capita consumed in auto transportation is made. This estimate is derived by multiplying travel demand in year t

by a constant (125,000 Btu's/gallon). The constant may change due to changes in fuel mixture (i.e., gasohol). This is derived by the load factor which is multiplied by the fleet fuel economy. Finally, Btu's per capita is multiplied by the total population providing an estimate of total demand for energy in the auto transportation sector.

Truck freight energy demand is determined in general by the following factors. These factors are: (a) growth in the local economy, (b) efficiency of the vehicles, (c) load factor, (d) travel demand (expressed as truck miles per capita), and (e) energy intensity which expresses the Btu's consumed per truck mile.

Bus traffic demand is made up of commercial (urban buses) and school buses. Growth and change in the demographic model in REEIS directly influences the demand for school buses. Demand for commercial urban bus transportation is a function of: (a) the price of gasoline, (b) the availability and accessibility of transit links, and (c) the time required to complete a trip.

Travel estimates expressed in person-miles are converted to Btu's consumed per person mile in bus transportation. This considers the efficiency of urban public transportation in terms of Btu's consumed per vehicle mile and travel demand over time.

APPENDIX C

SUMMARY OF LOCAL GOVERNMENT ENERGY PROGRAMS

BAY AREA COUNTY ENERGY PROGRAMS

Alameda County

Prior to Proposition 13, Alameda County had begun work on an energy element to the County General Plan. However, work was stopped following passage of the tax cut initiative, with no immediate plans to resume.

The County Planning Commission recently set up a subcommittee on energy that will be looking at measures that could be taken in new development. Measures being considered are guidelines on passive solar heating, clotheslines, landscaping, siting of structures, and conditions on planned unit developments such as carpooling, shuttle service, water conservation devices, and solar option.

Within County operations energy wastage in buildings and equipment has been identified. However, the money for staff and equipment to make changes has not been forthcoming. Adjustments in temperature control have resulted in drops in consumption. County vehicles are being replaced with sub-compacts. A test program using gasohol in vehicles recently began, but has encountered some initial problems.

The primary constraint in Alameda appears to be lack of funding to do energy planning and management. The County currently has no outside funding to do energy work.

Contra Costa County

Contra Costa County has formed a broad-based Solar Energy Advisory Committee (SEAC) that makes recommendations to the County Board of Supervisors regarding energy conservation. The immediate goal of SEAC is to establish energy conservation policies at the Board level. SEAC is scheduled to release a report in June 1980 describing energy conservation measures that were proposed, rejected, or adopted in the County. Contra Costa County is undertaking interal energy conservation measures in County buildings and vehicle fleets. Changes were made to conserve energy in space and hot water heating and lighting in County buildings. The County is also operating carpool and gasohol programs to reduce vehicular energy consumption.

Contra Costa County is expected to become more active in the areas of energy planning and private sector influence in 1980. The type and magnitude of activity will be influenced by the SEAC report scheduled for release in June 1980.

Marin County

Until recently, energy programs in Marin County were limited to increasing energy efficiency within County buildings and operations. However, in 1979 the County began an update of the Land Use and Transportation Elements of the 1973 Countywide plan. An energy element of the Countywide plan will be prepared and completed by September 1980; the intent is to integrate energy considerations into all elements of the plan and will include an Energy Conservation and Management Program.

The Board of Supervisors appointed an Energy Conservation Advisory Committee in November of 1979. The County has hired a consultant for its energy planning. In addition, a separate organization, Marin Citizens for Energy Planning, has received Energy Commission funding to work directly with Marin cities in code revision to build in energy conservation. The two organizations are working closely together and see their work as complementary. The County effort will focus on general policy planning, particularly land use and transportation. MCEP will focus on code and process revisions, solar feasibility, and educational services.

A recent technical report, "Energy Options for Marin County," suggests that the County consider a wide range of possible conservation options to be implemented by all sectors. The options are divided into seven energy demand sectors. Further evaluation will narrow the list of options to specific actions including implementation techniques. The County will also look at alternatives to nonrenewable resources.

Internally, the County began about five years ago to institute energy conservation measures. The heating, ventilation, and air conditioning systems in the Civic Center have been modified to limit peak demand use using a computer system, to recycle air, and adjust temperature control. With additional funds, other more expensive improvements are proposed. Delamping and relamping has occurred in buildings and parking lots with significant reduction of power consumption in some areas. Some smaller cars and trucks are replacing larger ones where possible. The County recently received a PG&E award for reduction in power consumption.

Napa County

Napa County has an energy element approved in concept but not officially adopted by the County Board of Supervisors. The concept of the element is contained in the 1978 Annual Report of the Napa County Energy Conservation Commission. This report was prepared using local funds.

The Napa Energy Conservation Commission is an advisory group consisting of appointed volunteers; it was formulated in 1977 by the Board of Supervisors, disbanded in 1978 (due to proposition 13) and was reappointed in November 1979. The Board also appointed a County energy coordinator to act as a focus for gathering energy information.

Currently the commission has no assigned staff; temporary staff will be assigned as needed for specific project.

The County has been practicing in-house conservation measures since 1974, when it made changes in the heating, ventilation, air conditioning, and lighting of County buildings. Easily implementable internal conservation measures with quick payback were instituted first.

San Francisco, City and County of

The City and County of San Francisco has begun an energy program with funds from the Energy Commission, DOE, and the Urban Consortium. The goals of the Energy Commission grant are to reduce consumption in San Francisco and to promote private sector conservation. The program is funded for about $300,000.

San Francisco does not have an energy element, but there is some staff level interest in seeing one done.

The City and County set up a Mayor's Interdepartmental Conservation Task Force in 1978 aimed at reducing internal energy consumption. Also an energy planner has been hired to do specific work in neighborhood energy conservation. Although the city and County has not had a coordinated city wide approach, a new proposal is before the PUC that would centralize energy programs. The proposal would establish an Energy Conservation and Resources Management Bureau in the PUC, responsible for the development and implementation of a comprehensive energy conservation and management program. A goal is to reduce consumption by 20% over 24 months within the city's own operations. This would be accomplished through energy audits, maintenance procedures, installation of conservation devices in city buildings, purchasing standards, as well as possible major improvements such as street lighting, boiler operations and generation.

Energy audits are being performed on some buildings. Retrofitting buildings have yielded annual cost and energy savings.

The city recognizes that its building and planning codes often discourage energy conservation. The new program would work to modify codes to promote conservation practices.

The proposed Bureau would also conduct a consumer awareness campaign and promote business development in the energy field. The city sees an important connection between the expanding energy field, and economic development and jobs.

San Mateo County

At the present time San Mateo County does not have a comprehensive energy management program. In the latter part of 1979 the County formed an Energy Conservation Task Force (ECTF), which is a broad-based committee consisting of appointed volunteers. The ECTF holds monthly meetings at which energy conservation measures are proposed and discussed. Public education and zoning and ordinance changes are two measures of major interest in the ECTF.

Internal energy conservation measures undertaken by the County include changes in the lighting, heating, ventilation, and air conditioning systems of County buildings, and a program for operating some County vehicles on liquid propane.

Santa Clara County

Santa Clara County has done extensive background work on energy management and planning for the County. A series of background reports discuss energy supply and demand, alternative energy sources, residential energy conservation, and internal energy management. These are not policy documents, but serve as a basis for programs now beginning. The County has begun preparation of an energy element for the general plan, but this is receiving less emphasis than implementation of energy conservation measures.

An Energy Task Force set up in 1976, guided the preparation of the background studies and completed its work in 1978 with a recommended energy action plan to the Board of Supervisors. Policies on internal conservation measures from this action plan were adopted by the Board in May of that year. A Solar Energy Technical Advisory Committee looks primarily at opportunities for solar energy in the County.

Within County facilities and operations, measures, such as use of gasohol for vehicles, recycling used oil, computer system to control HVAC in buildings, have been implemented. Other measures being implemented or proposed are designing new building for solar, retrofitting old buildings, and car-pooling among employees.

Currently, the County has four draft ordinances for consideration by the planning commission and the board. They are:

- o Ordinance requiring energy audit and energy conservation measures
- o Ordinance restricting the use of natural gas heating for residential swimming pools
- o Ordinance requiring solar water heating for new residential construction
- o Ordinance requiring solar access for new construction and development.

The County under a new Energy Commission contract will be involved in public workshops for aspects of energy conservation yet to be determined.

Solano County

Solano County currently has no comprehensive energy management program. In December of 1979 the County formed an Energy Task Force (ETF), which is a citizens advisory committee consisting of appointed representatives from the County Board of Supervisors, County Taxpayers Association, Citizens from each Supervisory district, Pacific Gas and Electric Co., and others. The ETF is supported by staff from the County Administrator's Office, Planning Department, and Public Works.

One of the objectives of the ETF is a °nuts and bolts' approach to energy conservation, i.e., performing the easily-implemented technology-oriented conservation measures first (e.g., lighting changes, heating changes, etc.).

The ETF is currently preparing a list of conservation measures that could be implemented in the County.

In the more distant future, the ETF is interested in preparing an energy element and in drafting energy conservation ordinances, e.g., requiring solar heat on swimming pools.

Sonoma County

Until very recently, Sonoma County's energy conservation work focused on reducing County energy consumption. Changes in the heating, ventilation, air conditioning and lighting systems resulted in a 20% reduction in consumption in 1974. Sonoma County is also reducing the fuel consumption of its vehicle fleet; in recent years, most of the County fleet has been replaced with four cylinder vehicles. In addition, an employee car pool program has been established.

The County Administrator's office has done much background work to initiate Sonoma County's energy management program. In November 20, 1979 the CAO submitted a report to the Board of Supervisors recommending the adoption of a Countywide energy conservation program. Major recommendations of the report include:

- o appointing a ten member broad-based Energy Technical Advisory Committee;
- o authorizing an additional full-time professional and one half-time clerical position in the County planning department as support staff for the committee;
- o instructing staff to identify state and federal funding for energy work;
- o instructing County departments to formulate then respective segments of a County energy program.

Alameda, City of

The City of Alameda has taken considerable initiative in planning and implementing energy conservation and energy production. A Citizens Advisory Commission (CAC) has been constituted with representatives from City departments, PG&E, developers, and special interest groups, appointed by the City Council; the CAC advises the planning commission and is staffed by the planning department. The City's municipal utility, the Bureau of Electricity, has coordinated energy conservation efforts.

A draft energy element was recently approved by the Planning Commission and was to be reviewed by the City Council in December 1979. The element was prepared with a grant from the Calfornia Energy Commission with City in-kind service match. The element proposed a new energy department be formed within the City's administrative structure.

The City has conducted energy audits of City buildings and has taken steps to increase internal energy efficiency. Also, the Bureau of Electricity is seriously exploring the construction of a waste-to-energy facility to generate its own electricity, as an alternative to purchase from PG&E.

The Draft Energy Element includes numerous energy conservation measures for consideration, including:

- construction requirements on new buildings;
- improvements to circulation;
- incentives for transit use;
- energy audits on City's own facilities and implementation of internal measures;
- energy education.

While energy conservation measures have been formally adopted as City regulations, the planning commission has incorporated energy conservation conditions in the permit review process where possible. Measures being incorporated in subdivision design are solar heating of pools, alternative transportation, a commercial/office/residential mix of uses.

The utilities have encouraged public participation through advertisement and bill inserts.

Berkeley

In 1976 the City of Berkeley became involved in energy planning and in May 1977 set up the Energy Conservation and Alternative Development Commission. The nine member commission is appointed by the City Council and staffed by the Department of Code Enforcement. An Energy Conservation Task Force, made up of City department directors, was formed to look more specifically at internal energy conservation measures. The Commission is volunteer and the City has not funded specific staff positions for energy planning. No outside funding has yet been received, although sources are being explored.

In October 1979 the Energy Commission adopted a work plan for the development of a comprehensive energy plan for Berkeley. The program includes investigating possible energy conservation and energy production in various sectors. It emphasizes local control of energy resources where reasonable. No schedule for completion has been set and no funding is yet available.

Energy conservation measures already implemented incude covers on City swimming pools and cutting down on energy use in City buildings through energy audits. Measures such as delamping and elimination of hot water, have resulted in an estimated 10% cut in energy use in the City hall.

No City ordinances currently regulate private sector energy use. A proposed requiring weatherization upon sale of residents was rejected as hard to enforce.

The work plan contains possible energy conservation measures for future consideration, including:

- o insulation/weatherization;
- o energy audits;
- o changes in street lighting;
- o individual metering of units in multi-unit buildings;
- o rate structure revision;
- o energy efficiency standards;
- o peak load redistribution;
- o clotheslines;
- o mixed use zoning.

Fairfield

The City of Fairfield prepared an energy conservation element for the General Plan in September 1977. The element was recently amended, and is expected to be adopted by the City Council in early 1980. The element, which was prepared entirely with local funding, first discusses current and projected energy supply and demand. The element also addresses the impacts of City policies on local energy conservation, and discusses the role of local government in effective energy planning. Lastly, the element discusses specific energy conservation measures of the energy management program including those that should be taken immediately and those that should be implemented in the future. Examples of the former measures include internal operations changes (lighting, heating, ventilation, and air conditioning changes in municipal buildings; vehicle fleet changes, etc.) and examples of the latter include community-oriented regulating and planning activities (zoning, energy audits, development, etc.).

The element does not recommend measures requiring technological break throughs or dramatic changes in the lifestyles of Fairfield's residents. Most of the meaures not only cost little to implement but will save the City and its residents money once implemented.

Fairfield is active in conserving energy in its internal operations. Because of its energy element, the City is at least partially active in the general areas of planning and private sector influence.

Hayward

The City has no formal energy program and has no energy element. Funding and staff limitations have been a constraint on doing energy planning or on seeking outside funding.

Steps have been taken to reduce energy use within City operations. These measures include converting street lights in one section of the City to high pressure sodium lighting, conversion to flourescent lights in City hall, conversion of City cars to economy models, and education of City staff on gas-saving hints in driving.

Livermore

On April 9, 1979 the City Council of Livermore adopted an energy element to the General Plan. The element was prepared with local funds by the Livermore Energy Committee. The element first discusses background information pertaining to energy consumption by sector in the United States, California, and Livermore. Next, alternate energy sources that could be used to meet the demand are discussed. There are two broad categories of energy measures presented in the element: conservation and development and utilization of alternate energy resources. The conservation goals and policies are directed towards the following areas:

- o Land Use - siting of developments to reduce energy used by the buildings and consumed by transportation to and from the developments; landscaping to reduce energy needed for heating and cooling;

- o Building Design - designing buildings to maximize energy efficiency;

- o Appliances - minimum levels of operating energy effeciency;

- o Transportation - planning for pedestrian walkways, bicycle paths, public transportation and high-occupancy vehicles.

The goals and policies for developing and utilizing alternate energy resources are directed towards solar energy, recycling, and solid waste conversion.

In addition to its energy element, Livermore is also active in the area of energy conservation regulations and ordinances. In December 1979 an ordinance requiring R19 insulation in the attics of homes at the time of sale was adopted by the City Council.

By virtue of its energy element and energy committee, Livermore is active in five of the seven energy conservation measures covered by this survey.

<u>Martinez</u>

The City has no formal energy program or committee structure. However, standard energy conservation requirements for major subdivisions and small subdivisions have been adopted and are used in the permit review and EIR process. These requirements include:

- o insulation and weatherstripping;

- o orientation;

- o lighting;

- o solar-heating of swimming pools;

- o energy-saving options;

- o yard landscaping.

Other measures being considered are a parking ordinance, bicycle path system, and street lighting requirements. Developers seem to have no objections to these conditions.

Energy work was initiated by the City; no outside funding has been received.

Mountain View

Mountain View's energy conservation activities are currently focused on internal operations. Municipal buildings follow federal and state heating and lighting recommendations, and energy audits are performed on City-owned buildings. Street lighting, which accounts for one third of the City's total power consumption, is being changed with local funds. In new lighting installations, high-pressure sodium lights are being used; also, the City is converting some existing incandescent lamps to high-pressure sodium lamps.

In order to reduce gasoline consumption by City vehicles, the City imposes travel restrictions, performs maintenance checks on the vehicles, and is replacing vehicles with more fuel-efficient models.

In the area of alternate energy sources, Mountain View has installed solar heating panels on its municipal pool, and is nearing the end of its demonstration project for producing gas from its landfill. The landfill project was funded by Pacific Gas and Electric Co., the Environmental Protection Agency, and a private corporation.

The City is also involved in the preliminary phase of a resource recovery project with five other cities in northern Santa Clara County. The project is examining recycling and power generation from non-recyclable waste components.

Napa, City of

Current energy conservation activities began in Napa in October 1979 when the Housing Commission presented a list of energy conservation recommendations to the City Council. The council supported most of the recommendations and appointed a Citizen's Energy Committee (CEC) to develop ordinances and compile data. The CEC, which presently functions without staff assistance, includes representatives from Pacific Gas and Electric Co., the Napa Housing Commission, and private citizens interested in active and passive solar systems.

The Housing Commission report to the City Council identified five energy conservation measures that should be implemented, discussed the need for preparing an expanded energy element to the General Plan (Napa prepared a brief energy element in 1979), and identified ways to promote energy conservation through public education, use of alternate energy resources, revision of codes and regulating and changes in internal operations.

Current energy conservation activities in internal operations include changes in space heating, water heating, air conditioning, and lighting. The City received a PG&E reward for reducing internal energy consumption by 20-25 percent last year. The City is also replacing City vehicles with more fuel-efficient models.

Oakland

At the present time Oakland does not have an energy conservation plan. The Office of General Services (OGS) was assigned in 1979 to prepare an outline for such a plan.

Although not currently guided by an overall plan, Oakland is engaged in a number of energy conservation activities in the areas of internal operations, administration, and private sector influence. Internal operations activities include:

- o Feasibility study of using cogeneration at the City Center Complex (system could cut energy requirements and operating costs by thirty percent);
- o Street lighting conservation program (saves 10% of total OGS budget per year);
- o Traffic signal program (reduces energy use 6.4% per year);
- o City building electricity consumption reduced by 31% since 1974;
- o City building natural gas consumption reduced 26% since 1975;
- o Vehicle fleet changes (gasohol programs, use of compact cars, use of diesel-fueled fire and construction equipment).

Administrative activities include centralization of fuel and utility accounting, compliance of new City facilities with State energy conservation standards and preparation of a comprehensive energy plan.

Activities influencing the private sector include an energy conservation community action program to assist low income families in conserving energy and a program of State energy conservation standards enforcement for new building designs.

Future energy conservation programs under consideration by Oakland include:

- o training CETA workers to install solar equipment on City buildings and swimming pools, to retrofit City buildings with weatherization materials, and to modify City structures for passive solar heating;
- o energy audits of all City facilities;
- o purchase of electric or hybrid vehicles for City fleet;
- o mandatory inclusion of the use of solar or alternate energy sources for new buildings;
- o establishment of energy conservation purchase standards for appliances, motors, and gasoline mileage for motor vehicles.

Palo Alto

Palo Alto's energy conservation program began in 1973 with an extensive in-house conservation effort. The program was expanded in 1976 to include low-income weatherization, solar feasibility studies, and drafting of an energy element to the comprehensive plan.

The "City of Palo Alto Resource Management Plan" (the energy element) was adopted by the City Council in April 1979. The Resource Management Plan (RMP) presents a detailed description of Palo Alto's supply of and demand for electricity, natural gas, water, petroleum, solid waste, and solar and wind energy. It then describes specific policies and programs for effective management of these resources. Objectives of the RMP include preservation of scarce resources through more efficient use, minimizing the costs of supplying energy and disposing of wastes, equally distributing the hardships and benefits of resource consumption and conservation, and continually assessing the RMP policies for relevance to new technologies or availability of resources. Preparation of the the RMP was done with local funding.

Petaluma

The City has no formal energy program. A constraint on formulating an energy element or other energy planning has been the lack of funds for energy work in the City budget.

Within the City's own operations modifications to heating and lighting have been implemented. The City is considering relamping street lights. Within the subdivision review process, the staff informally encourages energy-efficient practices, such as site orientation and street lay-out.

Pinole

Under a small California Energy Commission grant, Pinole City Council set up an energy committee to investigate energy conservation possibilities. The committee completed its report in 1979, recommending measures for consideration in that City; ideas included retrofit of existing homes for weatherization, orientation for new housing, commuter parking, and public education. The Council wished to emphasize voluntary measures rather than impose new controls through regulation; the energy committee was asked to rework its recommendations. No new programs or code modifications have come out of this work to date.

Internally, the City has taken limited steps for conserving City energy use. PG&E has been done an energy audit of the City buildings and is changing over the street lights to the sodium vapor lights. Within City facilities some heating and lighting changes have been made.

Redwood City

While the City currently has no energy plan, interest at the staff level has been expressed in doing one. There is no formal energy planning structured beyond staff meetings organized by the City Manager's office.

No regulating measures have been adopted for new development. Low pressure sodium lights have been installed along El Camino Real, a State project. Other conservation measures being considered are alternate street light delamping and incentives for use of bicycles.

Richmond

The City of Richmond currently has no comprehensive energy management program. The Richmond does have an Energy Task Force (ETF) consisting of representatives from the Finance, Public Works, and Building Maintenance Departments. The goal of the ETF is to implement internal energy conservation measures. Activities of the ETF have included:

- o street light changes (incadescent to high-pressure sodium);
- o lighting changes in City buildings;
- o purchasing fuel-efficient vehciles for City fleet;
- o new thermostat installation in City buildings.

These and other activities produced an energy savings of 15-28% in 1975. Long-range plans include the possible installation of solar collectors on City buildings.

San Leandro

Although no separate energy element has been prepared by San Leandro energy concerns have been incorporated in the Air Quality, Energy, Land-Use Element adopted in 1975. More recently, the public works and fire department have been looking into the preparation of an energy contingency plan for the City. An inter-departmental energy committee makes recommendations to the City Council.

Energy programs have focused primarily on internal energy savings within City operations.

Through measures such as time switches for controlling facility energy use, restrictions on heating and cooling in buildings, and relamping street lights, the City realized a $63,000 cost savings between 1977 and 78. Natural gas use was reduced as well. The strategy has been to begin with low-cost measures first. No citywide regulations control private energy use. The City would prefer to use voluntary programs, encouraged through public education.

San Jose

The City has been involved in energy planning since mid-1976. Early efforts involved assessing City operations for energy efficiency and the formation of a citizens participation group to look at community energy use. A staff-level task force was set up initially to direct energy conservation programs within the City operations.

The San Jose City Council, in conjunction with future work on its general plan, intends to include energy as one of the items in it focused approach. There is no energy element; however, existing City policies on energy will be expanded.

Within the City operations, the Public Works Department has conducted energy audits of City buildings and has instituted computerized control of heating, ventilating, and air conditioning operations, as well as management of lighting. Smaller police cars have been purchased. Within some areas of the City high- and low-pressure sodium lighting is being tested.

No formal measures have been instituted to regulate private energy use. Conservation measures being considered are minimum insulation requirements for resale of buildings and solar heating of swimming pools.

South San Francisco

South San Francisco currently has no comprehensive energy management program. Their energy conservation activities are focused on internal conservation measures. The local mechanism for energy planning is the South San Francisco Energy Conservation Committee (SSFECC), which is a broad-based advisory committee appointed by the City Manager. SSFECC members include representatives from Pacific Gas and Electric Company, Police Department, Fire Department, Chamber of Commerce, Standard Oil, School District and others. The SSFECC receives some locally-funded staff support from the City; to date the following conservation measures have been implemented in South San Francisco:

- o replacing City street lights with high pressure sodium lamps;
- o converting police cars and other City vehicles to operate on butane;
- o replacing fire department vehicles with diesel equipment;
- o operation of a combined-cycle disposal plant--waste heat from the plant operation is used to heat the air and water in the plant.

  The South San Francisco General Plan is currently being updated; although no energy element per se is being added to the plan, the plan will have a "design review element" that will consider issues in new construction.

Sunnyvale

The City of Sunnyvale is undertaking a wide variety of energy conservation activities. It is currently revising and updating a 1974 "energy policy" for the City under local funding. The updated version, which should be implemented in early 1980, dictates energy conservation

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The City of Sunnyvale is undertaking a wide variety of energy conservation activities. It is currently revising and updating a 1974 "energy policy" for the City under local funding. The updated version, which should be implemented in early 1980, dictates energy conservation measures to be used by City offices and facilities.

Currently the local mechanism for energy planning in Sunnyvale is the Sunnyvale Energy Committee (SEC), which is an internal advisory committee representing the major departments of City government (community development, planning, building inspection, City Manager's office, etc.). The SEC studies and recommends internal energy conservation measures; some internal measures currently being taken include:

- o conversion of all City street lights from incadescent to high-pressure sodium lamps;

- o energy audits of City buildings,

- o converting the City building lighting to high-efficiency fluorescent lights;

- o employee carpool program expected to become operational in April 1980.

- o feasibility study of retrofitting some City buildings with solar equipment;

- o changes in space and water heating.

Some long-term energy conservation projects currently under consideration by the City include:

- o generation of methane using digestion of algae from water pollution control facilities; the methane would be used to power City operations, including building heat, water pollution control plant processes, and possibly even motor vehicles; the University of California has recently completed a feasibility study for the City;

- o generation of methane at City landfills;

- o use of wind power to move water at water pollution control facilities.

In terms of private sector influence, the Sunnyvale Planning Department is examining some solar ordinances for submission to and possible adoption by the City Council. In February 1980, the City plans to appoint a broad-based Citizen's Energy Advisory Committee.

Vallejo

The City participates on a county commission that has been formed for energy planning and has set up its own subcommittee to the City Council on energy. There are no plans to prepare an energy element.

Internally, the City has taken steps to improve its own operating efficiency. Lighting has been reduced in City buildings. Considerable energy savings were realized in the City Hall; the City was recognized by PG&E for energy use reduction. About half of the street-lights have been converted to high pressure sodium lamps. Other ideas being considered are insulation in the fire stations, solar film, and maintenance programs for motor efficiency.

In the subdivision review process, the City requires developers' participation in the PG&E premium program. Other City-wide measures being considered are requiring insulation during rehabilitation and a pre-sale ordinance to require compliance to insulation standards.

The City has undertaken a public awareness program on cable TV, where private conservation measures are demonstrated.

OTHER ENERGY PROGRAMS

Many local governments outside the Bay Area have unique, extensive, and successful energy programs. In addition, there are several State and Federal agencies either directly involved in or indirectly influencing energy activities at the local level. In an effort to bring to Bay Area local governments as much successful experience and technical and planning experience as possible, other local governments, particularly notable for their energy conservation programs were contacted. Brief summaries of these programs are included below.

Burbank, California

Burbank operates its own municipal utility and has been actively involved in energy management programs. Responding to the 1973 energy crisis the city passed an energy conservation ordinance. The ordinance places restrictions on lighting of business signs, sporting events, and holiday displays. Heating and cooling standards for commercial buildings are in effect. Large electricity users must have approved conservation and curtailment plans. The city has no energy master plan, but has passed an Energy and Natural Resources Policy. Public outreach has been used to promote private energy conservation as well. The City is also considering alternatives to fossil fuels as generation sources.

Davis, California

The City of Davis has been actively involved in energy management planning since 1975, when it enacted the first energy conservation municipal building code in the country. Since that time further energy conservation is a major factor in Davis' planning program. Considerable attention is paid to solar access, landscaping, street width, etc. The City has been very active implementing internal conservation measures as well. The unique aspect of the energy program in Davis is that it demonstrates the extent to which local governments can influence their community energy supply and consumption.

Los Angeles, California

Under Federal Department of Energy funding, the City of Los Angeles is preparing an energy element to the General Plan; the element is scheduled to be completed in 1981. Also, under the same funding, the Los Angeles Energy Managment Board (LAEMB) was formulated; it meets monthly and consists of citizens nominated by city councilmen. The city has an active energy conservation program for city buildings, street lights, and vehicles. Los Angeles is considering ordinances and building code changes to promote solar energy. The public relations program for the LAEMB is conducted through the Mayor's Office.

Long Beach, California

Long Beach does not have an energy element, but the other elements of the general plan address energy issues. In January 1980 the Energy/Management Division (EMD) of the Public Works Department was formed. The EMD is staffed with four engineers plus a supervisory Division Engineer. For the most part, the EMD will be self-funded; that is, the monetary value of the energy saved through their activities will be used to pay their salaries. These funds will be supplemental by Federal monies as available. The primary focus of the EMD will be implementing the easy-to-implement, quick-payback internal energy conservation measures. The city has already done extensive work in this area. Long Beach has had an Energy Conservation Committee (ECC) since 1973; the ECC has been active in implementing internal measures and also in establishing public outreach programs such as weatherization assistance for low-income families.

San Diego

The City of San Diego has been active in energy management and energy planning for several years. Measures to reduce internal energy conservation began in 1973 with techniques such as lighting reductions, changes in heating, ventilation, and air conditioning, vehicle speed reductions, carpool programs, etc. In 1976, the city adopted an energy conservation policy aimed at reducing energy use in city operations, city-regulated facilities, and the private sector (e.g., encouraging reduced ornamental lighting, mass transit uses etc.).

Since 1973 internal conservation measures have saved the city approximately $1.9 million. San Diego currently has an energy element to the General Plan; the element was prepared with local funds. The Mayor's Office is in the process of establishing an ongoing mechanism for energy planning in the city, in the form of a committee or task force. The committee is expected to begin meeting in February 1980. The City Planning Department is currently considering a solar access zoning change that would consider, among other factors, building orientation in new developments; this zoning change is expected to be presented to the city council for action in March 1980.

Santa Barbara

Santa Barbara has recently completed its Draft Energy Element to the General Plan; the element was prepared under a grant from the California Energy Commission. The City has had a active internal conservation program since 1976. Adoption of the Energy Element by the city council will result in an expanded internal conservation program and an extensive public outreach program including public education, and zoning and ordinance changes.

Jacksonville, Florida

Jacksonville has established two energy planning offices in the city government. The Mayor's Energy Office, which focuses on internal conservation measures, and the Jacksonville Electrical Authority Energy Audit Office, which focuses on public outreach and reducing residential and commercial energy consumption. The city is actively involved in implementing internal conservation measures, and has adopted a solar orientation ordinance for new home construction.

Portland, Oregon

Portland stands as one of the better known and more successful examples of local energy conservation. Starting with a HUD grant in 1975, Portland developed methods to determine city energy consumption and reduce consumption through energy conservation. Following this extensive background work, the city began to take action to conserve energy. Techniques included changing internal operating practices, making capital investments where necessary, energy audits on city buildings. The city council supported capital investments by directing that 0.5% of the General Fund and all applicable "Special Funds" be used for conservation. In 1979 extensive work by a citizens committee and technical advisory task forces resulted in a proposed energy policy for Portland that would guide energy conservation city-wide through education, incentives, and regulations where necessary.

Pacific Gas and Electric Company

Although PG&E is not a local government, it is major energy supplier for the Bay Area, and its conservation programs have been greatly expanded in recent years, with a total budget of $80 million for 1980. Those programs are summarized here for completeness.

Pacific Gas and Electric Company's planned conservation activities for 1980 include six customer related conservation programs and seven other conservation activities. Customer related conservation programs are: (1) Weatherization Program, which promotes insulation and other building envelope improvements through financing, home audits, and incentives; (2) Appliances and Devices Program, which focuses on consumer awareness of appliance efficiency; (3) Energy Conservation Homes Program, which encourges builders to exceed State standards for energy efficient construction; (4) a multi-faceted Commercial-Industrial-Agricultural Program; (5) Solar Program of demonstration and monitoring prjects, and

incentives; and (6) General Awareness Program, which conveys the conservation message through consumer education and advertising campaigns.

In addition to these programs, the seven other conservation activities are: (1) energy conservation research and development, where the company tests and monitors emerging conservation products and concepts; (2) load management and load management research and development, which conveys the need for off usage by our residential and non-residential customers; (3) development of energy alternatives, such as cogeneration and solid waste recovery; (4) energy from biomass; (5) conversation voltage regulation, which involves voltage surveillance and feeder testing; (6) conservation programs at company facilities; and (7) a streetlight conversion program, which has, as its goal, conversion of the streetlights in PG&E territory to high pressure sodium vapor lights.

During 1979, PG&E conducted many programs which will be continued or expanded through 1980. Examples of these programs are:

<u>Weatherization Audit and Direct Sales Program</u>. The purpose of this program is to promote conservation in individual homes by providing PG&E customers with free energy audits. Over 60,000 audits are expected to be performed and insulation will be installed in over 12,000 homes in 1980. To accomplish this, the number of weatherization specialists will be increased to 114 in 1980.

The CPUC has recently ordered California utilities to promote residential insulation retrofits by installing low-flow showerheads and water heater blankets free of charge. PG&E began installing these devices in selected areas in 1979. The program will be extended to the entire service area in 1980.

The Insulation Financing Program offers financing of up to $500 at 8% annual interest for up to 5 years to customers who insulate their attics to R-19 or higher. The company expects to finance about 19,000 insulation jobs in 1980.

A new idea is the Sutherm Home Program. This program offers homebuilders incentives of up to $1,000 per unit if they incorporate certain passive and active solar design features in new homes. PG&E will continue to promote this program in 1980.

PG&E also conducts conservation programs for its Commercial-Industrial-Agricultural (C-I-A) customers. Two of these are the C-I-A Energy Utilization Audit (EUA) Program and the Agricultural Pump Efficiency Test Program.

The EUA program is aimed at customers using over 100,000 kWh and/or 50,000 therms a year. PG&E expects to complete 5,000 audits and 2,500 callbacks in 1980. Priority is given to governmental agencies to help them minimize operating costs.

The Agricultural Pump Efficiency Test Program is PG&E's oldest energy conservation program. 1980 will mark its 57th year. Farmers, municipal and private water companies, and other pump users request free tests, which determine pump efficiency. The company plans to test 8,600 pumps in 1980.

In addition to these continuing programs, the Solartap program is a conceptual solar financing and marketing alternative the company is considering. The program is designed to promote the sale of solar systems to multi-family dwellings with master-metered central water heating equipment. It will include both new and retrofit installations in multi-family building for which central water heating with gas or electric energy is an alternative (e.g., domestic water heating, swimming pool heating, laundry facilities, spas, etc.). The goal of this program is to reach a 5% participation of all master-metered multi-family units by the end of 1981 (about 10,000 units), increasing to a 90% penetration by the end of 1989. The program will be implemented after legislative authority has been provided; necessary federal exemptions have been received; analysis has been completed; and program implementation and rate recovery have been approved by the California Public Utilities Commission.

2/1/80

600 ABAG ENERGY ADVISORY COMMITTEE

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APPENDIX E

SOLAR LEGISLATION AND INSTITUTIONAL ACTIVITY SUMMARY

I. Legal

A. Federal Law

The Federal Energy Act provides the following incentives for solarization:

- o deregulation of natural gas prices by 1985 with gradual price ceiling increases up to that time;
- o loan programs for solar energy and conservation;
- o solar tax credits (both residential and business);
- o grants to schools and hospitals for energy audits and installations of energy saving measures, including solarization.

(Note: the President's goal calls for a 20% displacement of energy consumption with Solar by the year 2000).

B. State Law

Three major pieces of state legislation encourage solar energy use in California:

The California Solar Rights Act of 1978 contains the following provisions:

- o natural heating and cooling opportunities shall be utilized in all new subdivision designs to the extent feasible;
- o authorizes solar easements to be required by local governments in new subdivision parcels.

The California Solar Shade Control Act of 1978:

- o prohibits placement of any new vegetation that would shade more than 10% of a solar collector surface between 10 AM and 2 PM.

The California 55% Solar Energy Income Tax Credit:

- o provides an income tax credit for 55% of the cost of solar equipment and installation, up to $3,000.

C. Local Ordinances

As of January 1, 1980 no ordinances in the Bay Area require solar energy systems or solar access in new or existing developments. However several such ordinances have been drafted and are being considered for adoption, most notably in Santa Clara County. The following is a brief summary of key features of these proposals:

1. Solar Access Ordinances (proposed for Santa Clara County):

   o requires Solar access for new Construction (implements California Solar Rights Act).

2. Energy Audit and Conservation Measure Ordinance (proposed for Santa Clara County):

   o requires pre-1975 housing to retrofit upon sale to minimum energy conservation standards (to extent cost-effective).

3. Solar Water Heater Ordinance (proposed for Santa Clara County):

   o requires solar hot water heating system in all new residential units.

4. Natural Gas Heating Restriction Ordinance for Residential Swimming Pools (proposed for Santa Clara County):

   o prohibits gas connections for new pools after April 1, 1980;

   o prohibits gas connections to existing pools after January 1, 1985.

5. Solar Zoning Ordinance (proposed for the City of Santa Clara):

   o specifies that solar collectors are a permitted use in all city zones;

   o allows creation of airspace easements for protection of solar collectors' access to light;

   o establishes office of City Forester with the authority and duty to trim or remove trees which interfere with the access to sunlight of any solar collectors.

In addition, the cities of Gilroy and Morgan Hill in Santa Clara County have proposed checklists of Subdivision Design Review Factors which incorporate energy efficiency criteria in the design review process.

Two other local governments in California have adopted programs to promote solar energy: The City of Davis has adopted an Energy Conservation Ordinance which:

- o requires minimum thermal performance standards for new buildings.

San Diego County has adopted a Priority Processing policy which speeds permit processing for new developments using solar.

II. Institutional

The following agencies and organizations are performing tasks designed to promote solarization in California:

Solarcal Council

A 25-member body appointed by the Governor to develop a plan for solarizing California. This plan is contained in the Council's publication entitled "Toward a Solar California - The Solarcal Council Action Program."

Solarcal Local Government Commission on Renewable Energy Sources and Conservation

A 42-member body composed largely of local elected officials thoughout the State. Its members are charged with developing energy plans for their jurisdictions and assisting other communities to implement energy programs. It was formed in September, 1979 and has held two meetings.

Western Sun (Sacramento)

The Federal Department of Energy has set up four regional offices to promote solar. Western Sun in Portland is the regional office covering 13 western states. The California office of Western Sun receives funding from the Portland office to work on solar projects for the State. The most recent project, completed in Febuary 1979, entitled "Capturing the Suns Energy" was a survey of solar ordinances throughout California and the nation. Western Sun is now developing guidelines to assist communities in implementing a solar pool heating ordinance.

California Energy Commission-Solar Office

The Solar Office is engaged in numerous activities to promote solar in California, including:

- biannual reports to the legislature assessing California's energy needs;
- policy planning;
- developing technical information, such as a handbook to aid local government officials to implement solar energy programs (with the League of California cities);
- conducting workshops for builders (in conjunction with the California Building Industries Association) and for public officials (with the League of California Cities);
- providing financial assistance to local agencies and community groups to develop energy information programs (including a grant to Modesto Junior College to develop a regional energy information center, and a grant to Santa Clara County to disseminate its energy information to the cities in that county);
- conducting hearings on expanding Title 24 California building standards to include standards for solar;
- conducting the Testing and Inspection Program for Solar Equipment (TIPSE), a voluntary program which tests performance for solar equipment and publishes results;
- direct assistance to local governments.

Solar Business Office, California Business and Transportation Agency

An off-shoot of the Solarcal Council oriented toward promoting solar in the business Community. Recent activities of this office include:

- preparation and maintenance of a statewide directory of solar businesses;
- preparation of a real estate handbook - "How to Sell a Solar Home";
- a lending institution survey to determine loan policies regarding solar energy systems.

California Department of Consumer Affairs

The Department of Consumer Affairs has a solar installation unit which takes complaints from consumers with solar energy systems.

Office of Appropriate Technology (OAT), Office of Planning and Research, State of California.

OAT assists and advises the Governor and all state agencies in developing and implementing less costly and less energy intensive technologies of recycling, waste disposal, transportation, agriculture building design and resource conservation. One of its staff's four activity areas is energy programs.

Solar energy-related activities of OAT include:

- o publication of a brochure entitled "Present Value - Constructing A Sustainable Future" which provides examples of solar energy systems in residences and other buildings throughout the State;
- o publication of a bibliography for solar home builders;
- o development of a curriculum for solar training courses;
- o review of capital outlays for state buildings for enhancement of energy conservation opportunities;
- o building a solar greenhouse at Napa State Hospital as a demonstration project;
- o administration of energy outreach programs funded through the Federal Energy Extension Service. One such program will fund community organizations, such as a community college to train CETA personnel as solar equipment installers.

California Solar Energy Industries Association (Cal SEIA)

Cal SEIA is a trade association of builders, designers and manufacturers of solar energy systems formed with objectives to:

- o lobby for solar;
- o self-police the industry;
- o provide consumer confidence in solar.

The major current activity of the Association is the implementation of the Cal SEIA program to certify that solar systems have been installed in accordance with State Tax Credit guidelines.